THE EFFECT OF ORGANIZATIONAL CAPABILITIES TOWARDS R&D PROJECT INNOVATION PERFORMANCE E&E MANUFACTURING FIRM

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DOCTOR OF BUSINESS ADMINISTRATION
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ABSTRACT

Past literature indicates an unclear relationship between organizational capabilities and project innovation performance. This study investigated the impact of organizational capabilities on Research and Development (R&D) project innovation performance of manufacturing firms to fill the gap in the literature. In this study, the researcher proposed a framework where technological, marketing, customer relationship management, and management capabilities were hypothesized to enhance R&D project innovation performance. Four research hypotheses, underpinned by research-based view (RBV), were formulated to conduct the study. The study was a cross-sectional study which employed an online survey, and was conducted in Electronic and Electrical (E&E) manufacturing firms in Penang, Malaysia. Data from 56 responses were used to test the hypotheses by using regression analysis. The result indicated that marketing and management capabilities had a significant positive impact on R&D project innovation performance. However, unexpectedly, customer relationship management and technological capabilities did not show a significant effect on R&D project innovation performance. Of the significant predictors of innovation performance, management capabilities were found to be the strongest contributor, and it follows by marketing capabilities. The present study allows researchers and practitioners to gain an in-depth knowledge about the effect of management and marketing capabilities on the R&D project innovation performance in manufacturing firms. Practitioners are suggested to enhance their organization marketing and management capabilities to boost their R&D innovation project performance. As the study considered E&E manufacturing firms in Penang only, the generalizability of the findings could be limited. Future studies may consider expanding the research to the whole of Malaysia.

Keywords: Manufacturing firm, Organization capabilities, R&D project, innovation, E&E industry.

ABSTRAK

Sorotan kajian telah menunjukkan hubungan yang kurang jelas antara keupayaan organisasi dan prestasi inovasi projek. Kajian ini bertujuan menyelidik impak keupayaan organisasi terhadap prestasi inovasi projek Penyelidikan dan Pembangunan (R&D) firma pembuatan untuk mengisi jurang kajian. Dalam kajian ini, rangka kerja yang melibatkan keupayaan pengurusan teknologi, pemasaran, perhubungan pelanggan, dan pengurusan dihipotesiskan untuk meningkatkan prestasi inovasi projek R&D telah dicadangkan. Empat hipotesis penyelidikan yang disokong oleh pandangan berasaskan penyelidikan (RBV) telah dirumuskan. Kajian ini adalah kajian rentas yang menggunakan kaji selidik dalam talian, dan telah dijalankan di firma perkilangan Elektronik dan Elektrik (E&E) di Pulau Pinang, Malaysia. Data daripada 56 responden digunakan untuk menguji hipotesis dengan menggunakan analisis regresi. Hasil analisis menunjukkan bahawa keupayaan pemasaran dan pengurusan mempunyai kesan positif yang signifikan terhadap prestasi inovasi projek R & D. Walau bagaimanapun, keupayaan pengurusan hubungan pelanggan dan keupayaan teknologi tidak menunjukkan kesan yang signifikan terhadap prestasi inovasi projek R&D. Antara peramal penting dalam prestasi inovasi, keupayaan pengurusan didapati menjadi penyumbang terkuat. Ini diikuti oleh keupayanan pemasaran, penyumbang yang kedua kuat. Kajian ini membolehkan penyelidik dan pengamal dalam sektor ini mendapat pengetahuan yang mendalam mengenai kesan keupayaan pengurusan dan pemasaran terhadap prestasi inovasi projek R&D di firma pembuatan. Selain daripada itu, kajian ini mncadangkan pengamal supaya menguatkan keupayaan pengurusan dan pemasaran di organasi mereka untuk mencapai prestasi innovasi project R&D yang lebih baik. Oleh kerana kajian ini hanya mengambil kira firma-firma perkilangan E&E di Pulau Pinang, kebolehdapatan penemuan adalah terhad. Oleh itu, disarankan untuk mempertimbangkan perluasan penyelidikan ke seluruh Malaysia untuk kajian pada masa hadapan.

Kata Kunci: Firma pembuatan, keupayaan organisasi, projek R&D, inovasi, industri E&E.

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LIST OF ABBREVIATIONS

CEO	-	Chief Executive Officer
E&E	-	Electronic and Electrical
FDI	-	Foreign Direct Investment
GDP	-	Gross Domestic Product
HR	-	Human Resource
IP	-	Intellectual property
MyIPO	-	Intellectual Property Corporation of Malaysia
IPVT	-	Intellectual Property Valuation Training
IOT	-	Internet of Things
LED	-	Light Emitting Diode
MIDA	-	Malaysian Investment Development Authority
MNCs	-	Multinational Companies,
NPD	-	New Product Development
PLS	-	Partial Least Squares
PEB	-	Proactive Entrepreneur Behavior
R&D	-	Research and Development
RBV	-	Resource-based view
SME	-	Small to Medium Size Enterprise
SIRIM	-	Standard and Industrial Research Institute of Malaysia
SPSS	-	Statistical Package for the Social Sciences
TRIPS	-	Trade-Related Aspects of Intellectual Property Rights
WIPO	-	World Intellectual Property Organization
WTI	-	World Trade Institute
WTO	-	World Trade Organization

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter consists of eight sections. Section 1.1 illustrates the background of the study, which focuses on the overall view of Malaysia and the Penang E&E industry and also related innovation performance of organizations internationally. Section 1.2 explains the problem statement as well as the organization's technological, marketing, customer relationship management, and management capabilities towards the R&D project's innovation performance. Section 1.3 and Section 1.4 list the research questions and objectives of the study, respectively, followed by Section 1.5, which states the significance of the study, and section 1.6 that spells the scope and limitations of the study. Section 1.7 defines the key terms used in the research. The chapter ends with section 1.8, which shows the organization of the thesis.

1.1 Background of the Study

Globalization enables humans, organizations, and countries to have close integration and interaction for global business and investment. It has introduced new industrial business processes and practices with more flexibility in forming global organizational functions. It mainly reduces the limitation of time and location for the business setup (Brondoni, 2018). The global network has substituted the serial product processes, systems, and supply chain. Without the need for sequential operations, the industrial product delivery time can fulfill all the operational units' logistics and manufacturing requirements in the global network more efficiently (Brondoni, 2014). Furthermore, industrial processes are not necessarily located in a dedicated location, and they are

typically shared between multiple corporations. The manufacturing locations are not needed to be near to each other as well (Lambin, 2014). All these new industrial principles, shorter product life cycles, fast technological growth, and fierce global competition have increased the organization's pressure to innovate (Woschke, Haase & Kratzer, 2017).

Innovation is a critical factor for manufacturing companies to attain competitive advantage for revenue growth and long-lasting success (Corrocher & Solito, 2017). Based on its definition, innovation is an indication of new ideas and products being introduced to the market that may solve agitated problems or enable improvements such as cost reduction, faster or better process systems, organizational structure and network improvement, and development of new systems (Simmie, 2005). It can be the application of a significantly enhanced or a new invention either in the form of services or goods, industrial method, an original marketing technique, or an innovative organizational approach in commercial practices, external relations, or internal workplace (Pittaway, Robertson, Munir, & Neely, 2004). The product manufacturing process, marketing method, organizational operation process, or the product must be significantly improved or new to the company as the minimum requirement for an innovation (Statistical Office of the European Communities & OECD, 2018). Based on the past literature, innovative corporations achieve better output either in productivity and quality, profitability, and growth performance than those companies without any innovation (Taneja, Pryor & Hayek, 2016).

Forbes publishes the best 200 companies in Asia-Pacific with revenue of USD1 billion and below in Asia's Best Under a Billion list yearly. These companies have steady top

and bottom-line growth every year. These companies are selected based on standards, such as accounting practices, growth, profitability, and debt (Settimi, 2017). All these companies have commonalities, like being customer-focused and innovative. These companies' mission statements usually consist of keywords like 'innovation' and 'continuous improvement' (R-Moulton, 2017). Figure 1.1 shows that the number of Malaysian organizations that won the top 200 list is reducing drastically since 2013. Twelve companies were on the top 200 list in 2013, but only three companies in 2018 (Forbes, n.d.). Malaysia loses nine seats or 75% of the places from the top 200 list to other companies from other countries. It also means that Malaysia companies are losing their global competitiveness due to low innovation capability for high technology product and service development and enhancement (Rasiah & Chandran, 2017). The three Malaysian companies that won the top 200 list in the year 2018 are Vitrox, Elsoft, and Pentamaster, and all of them are from the Penang E&E industry (Jonathan, 2019). It is crucial to study the organizational factors that impact the company's innovation performance improvement in gaining competitiveness for sustainable success (Woschke et al., 2017; Zou, Guo & Song, 2017).

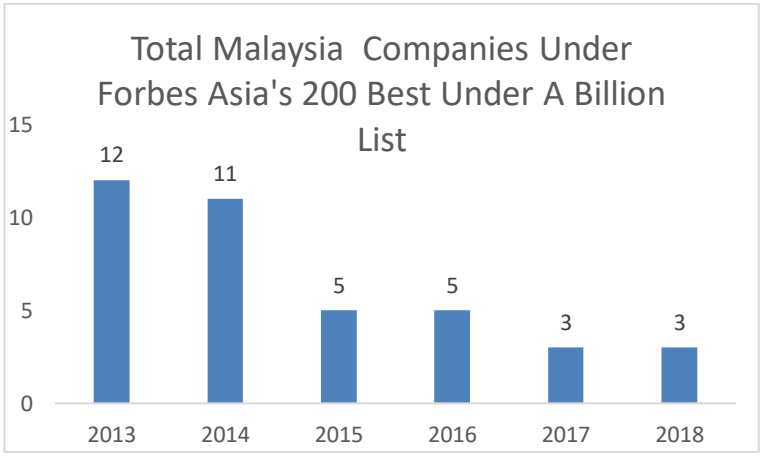

Figure 1.1
Total Malaysia Companies Under Forbes Asia's 200 Best Under A Billion List
Source: Forbes Asia's 200 Best Under A Billion List (2019)

According to MASTIC (2017), the expenditure on R&D projects in manufacturing organizations increased from RM14 million in the year of 2014 to RM17.6 million in the year of 2016, which is about an increment of 26% in the three years, as shown in Figure 1.2. The R&D human resources also increased from 114539 to 145740 headcounts within the same period, as illustrated in Figure 1.3. However, there is an incremental concern that the innovation standard of the new product development (NPD) projects, especially high-technology product development in Malaysia, are not as efficient as other countries because of no competent human resources and laboratory support (Rasiah & Chandran, 2017). According to MASTIC (2017), R&D innovation outputs in terms of the patent award have a downward trend. The total number of pattern awards fell from the year 2014 (745) to 2016 (536), as illustrated in Figure 1.4. The R&D publication and patent application drop were due to the external and internal factors. External factors include insufficient government funds, increasing capital costs, and lacking of required R&D experts. Internal factors include a lack of financial resources, limited time dedicated to R&D related tasks, and a weak reward system for R&D. (Rasiah & Chandran, 2017; MASTIC, 2016).

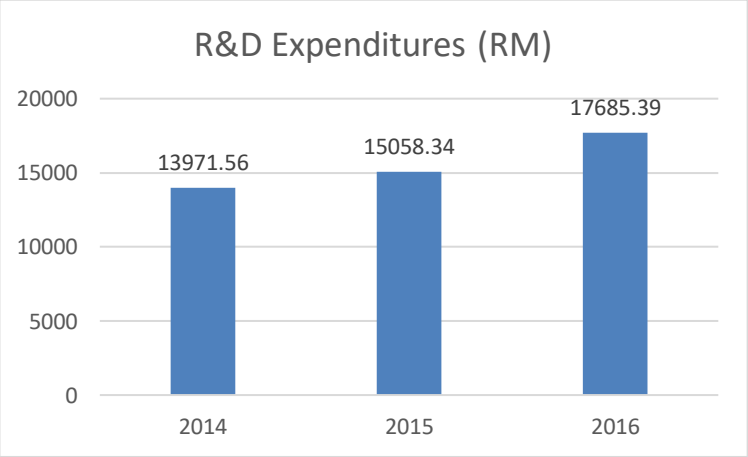

Figure 1.2
Total Malaysia R&D Expenses from 2014 to 2016 (MYR)
Source: MASTIC National Survey of R&D, 2017

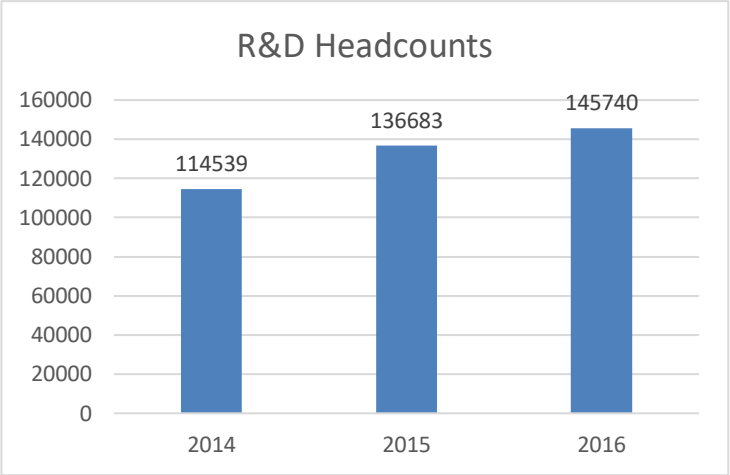

Figure 1.3
Total Malaysia R&D Headcounts from 2014 to 2016
Source: MASTIC National Survey of R&D, 2017

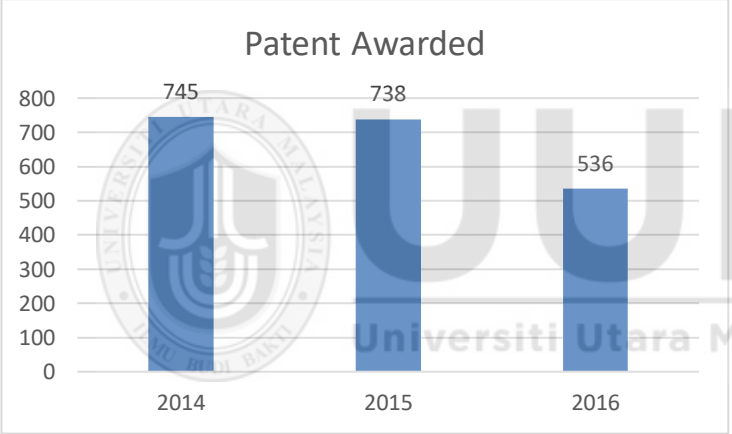

Figure 1.4
Malaysia R&D Intellectual Property Output (Patent Awarded) from 2014 to 2016
Source: MASTIC National Survey of R&D, 2017

Malaysia was ranked 37th in the year of 2017 compared to 32nd in the year of 2015 in the global innovation index. Besides, Malaysia was ranked 22nd in the year of 2018 compared to 14th in the year of 2015 in terms of global competitiveness. Malaysia's worldwide innovation and competitiveness rank drop was mainly due to the patent applications per capita, which dropped from 43rd in 2015 to 46th in 2018. The patent applications per capita are defined as the application number filed by applicant's origin, per 100,000 inhabitants (Dutta, Lanvin, & Wunsch-Vincent, 2017).

The job reduction and unemployment issues are the critical issues that arise with the low R&D project innovation performance. Manufacturing firms are not able to survive with no innovative products to compete in the market (Carr, Haggard, Hmieleski & Zahra, 2010; Holmes, 2010; Mas-Verdu, Ribeiro-Soriano, & Roig-Tierno, 2015). Based on Inui, Ito, and Miyakawa (2017), firms producing differentiated services or products are most probably better motivated to make early investments to start exporting their services and products. Organizations can sustain their export markets for a lengthier period with these upfront investments. Manufacturing firms are not able to extend their R&D capabilities with no support from foreign investors. They may keep the low skilled manufacturing operation, such as product assembly for a while, but it is not sustainable due to the threat of cheaper labor cost countries, like Vietnam. The affected manufacturing firms need to end their business and operation (Perkeso, 2019).

On the other hand, Indonesia, the Philippines, Thailand, and Vietnam are now considered to be the 'new Asian Tigers' in the Association of Southeast Asian Nations (ASEAN). These countries have participated in regional and global value chains. Some of them have been involved in sophisticated technology industries. These countries are aggressively improving their innovation performance and demonstrating extraordinary innovation results (Dutta, Lanvin, & Wunsch-Vincent, 2017). For example, Vietnam has authorized its ministries, agencies, and local governments to enhance the country's performance under the Resolution 19-2017/NQ-CP program in 2019. In Vietnam, the Ministry of Science and Technology (MOST) is authorized to coordinate the actions plan with the support of the ministries and local government agencies. They conducted

a workshop to leverage Vietnam's innovation strengths and overcome the country's weaknesses with the World Intellectual Property Organization (WIPO) in Hanoi, 2017.

1.1.1 Overview of Malaysia Electronics and Electrical Industry

Global trends influence the E&E industry but are also be impacted by the industry. There are tendencies to adopt more system and process automation in logistics, warehousing, and manufacturing amenities. More and more organizations in Malaysia have invested in R&D for intelligent building security, green technologies, up-to-date lean production, and innovative digital smart technologies implementation (MIDA, 2019). E&E manufacturing sector is recognized as the most significant industry contributing to the economic development of Malaysia with critical cross-industry networks and applications ecosystem. It includes new growth in mobile phone related electronics, wearable electronics, automotive electronics, internet protocol industrial technologies, Virtual Reality (VR), telecommunication systems, medical devices, Augmented Reality (AR), the Internet of Things (IoT), and personal computing.

According to Malaysia Investment Development Authority (MIDA) (2019), the E&E sector attracted RM8.2 billion, which was 84.5% of total industry investments, mainly from Japan and Germany in 2017. Besides, the E&E sector itself contributed RM343 billion, which was about 36.7% of overall Malaysia export earnings in 2017 (Malaysia External Trade Development Corporation (MATRADE), 2017). The E&E industry added over 780,000 jobs for Malaysians and contributed to 23.4% of Malaysia's gross domestic product (GDP) in 2016. Hence, the E&E industry is significant to Malaysia's economic growth, particularly in the global supply chain arena and the acceleration of knowledge or high technology-driven industrial development.

1.1.2 Overview of Penang Electronics and Electrical Industry

Penang is the top ten active global industrial areas that have established a successful manufacturing experience among the developing nations, according to the 2009 UNIDO industrial development report. It has been acknowledged as the first Malaysia Industrial Free Zone. Since the 1970s, Penang is very attractive to local and foreign E&E companies from Taiwan, the United States of America, and Japan (Invest Penang, 2019). It is also recognized as Malaysia's hub for E&E industrial development with its complete ecosystem to host export-oriented and labor-intensive E&E manufacturing companies. These manufacturing firms have excellent support services for companies to continue growing and accumulating manufacturing experience (Invest Penang, 2019).

Penang provides both local and foreign companies with several operational advantages and capabilities for them to thrive through cost reduction and exceptional experience. Most of the manufacturing firms in Penang have shifted from the manufacturing process to modern manufacturing practices that are characterized by value-added activities, domestic outsourcing of non-core businesses, and highly-skilled workforce. They have started the R&D activities for the full range of semiconductors, solar, test and measurement instrument, biotechnology, and LED segments. Therefore, Penang E&E sector is not only about job creation but also its engineering resources with solid technical knowledge and skills that have effectively enabled investors to compete on the global stage (Invest Penang,2019).

Intel is one of the typical examples that started with assembly and test activities. The company then evolved to take up a full internet of things (IoT) system R&D solution. Osram invests RM4.2 billion for its new state-of-the-art semiconductor facility

expansion. It is targeted to offer a total of 7790 job opportunities by 2020 in Penang. The facility expansion can be the world-class light-emitting diode (LED) factory, and a whole LED industry ecosystem. Robert Bosch Malaysia also invests RM2.6 billion to produce connectivity modules and instrument cluster panels that contribute to 194 jobs in Penang. Malaysia, as a country, has benefitted from Robert Bosch's efforts to develop local vendors and the export gains because the product is 100% made in Malaysia (MIDA, 2019). Other Penang manufacturing firms such as Lumileds, ASE, Jabil, Osram, Infineon, Motorola, and Panasonic are also the vital players participate in R&D activities aggressively.

The local Penang manufacturing industry firms, such as Elsoft, Pentamaster Corporation, Vitrox, SRM Integration, and Inari, also benefit from the strengthening of the manufacturing industry. In 2013-2018, Vitrox Corporation with a market cap at RM3.3 billion recorded net return 34% compound annual growth rate (CAGR) under the fierce competition and challenges from their well-known direct competitors, such as automated test equipment (ATE) companies from South Korea, Germany, Japan, and the US. Inari is a subcontract semiconductor assembly and test merchant with a market cap of RM5.6 billion, and it recorded sales CAGR of 42% in 2011-2018 (Invest Penang, 2019). Vitrox, Elsoft, and Pentamaster are the solely three Malaysian companies that won the 2019 top 200 Forbes Asia's Best Under a Billion corporations in Asia-Pacific (Jonathan, 2019).

According to Invest Penang (2019), the E&E industry contributed RM289 Billion, which was 38% of Malaysia's total export in 2018. It was about 11% increment from 2017 to 2018. Penang is the key contributor that drives the industry. Penang E&E sector generates more than 300,000 jobs and contributes more than RM1.5 billion in

monthly salaries to operate and boost the economy of Penang. Penang achieved a high GDP growth rate of 11% per annum from 1970 to 2008. The GDP grew from RM790 million in 1970 to RM49 billion in 2008. However, Penang GDP growth rate has decelerated to 5% in recent decades. Therefore, more industrial development and incentive funds are needed for better infrastructure establishment which helps to ensure the continual success of the Penang E&E industry. It is essential to safeguard the survival of Penang manufacturing firms for the social stability and economic growth of Malaysia by having a low unemployment rate (Perkeso, 2019).

1.1.3 R&D Project Innovation Performance Measure

In the fierce worldwide market competition, the R&D resources are critical intangible assets to establish big organizations' innovation and imitation policies for value generation (Brondoni, 2015). R&D anticipates demand tendencies and executes competition efforts, including collaboration with competitors for corporate and product performance improvement. The traditional models of economic and industrial development have been replaced with competitive imitation plans and program realization (Brondoni, 2012). A typical example is the Android mobile phone operating system (OS). Google, Huawei, Samsung, and most of the major Android phone makers are co-developing the OS platform for better security, features, and functionalities for their users.

A company can accelerate the growth of new services and products, create and expand new markets, transform industries, withstand the business, and improve the competitiveness of companies through innovation (Mueller, Rosenbusch, & Bausch, 2013; Nguyen, Chen & Lee, 2014). Companies need to have a method to measure their innovativeness. They cannot effectively manage innovation without understanding

their innovative level and status. A company can know its existing innovation capability and identify areas of improvement with a good measurement system (Chirumalla, Bertoni, Parida, Johansson, & Bertoni, 2013).

Typically, Penang E&E manufacturing firms conduct all R&D and innovation activities on a project basis. A project is a temporary effort commenced to develop an exclusive service, product, or result (PMI, n.d.). The skills, tools, knowledge, and methods applied to fulfill the project's needs are called project management. The performance of the R&D project is the key focus for company management and also academics. This is because it has a critical effect on an organization's development and long-term survival (Salimi & Rezaei, 2018). Wilson, Bhakoo, and Samson (2018) suggested that firms implement a crowdsourcing strategy, especially customer engagement, found to have a positive relationship with project management success. Implementing such a strategy is crucial because crowdsourcing encourages open operational innovation that boosts the success rate of project management.

R&D project innovation performance measures consist of product differentiation, patents quantity, and innovation success rate compared to peers (Zhao, Xiang, & Yi, 2017). In terms of product differentiation factor, it includes the application of technology that has never been applied to the industry before or that is the first in the market. It can be an organizational product that causes an essential change in the whole industry as it is highly innovative or entirely original in the marketplace. It also can be the company's product that has unique features or characteristics for customer usability, such as it allows customers to do something they can not do before. Lastly, the company's product can have higher quality and stronger specifications and better technical performance than a competitor's (Song & Parry, 1997).

According to Kenton (2019), a patent is an official agreement to grant an inventor a property right by the authority. An investor can exercise the incorporeal rights for the disclosure of their patented design, method, or creation within a given timeframe. A creation is patentable if it involves an inventive step, or it is new and applicable to the industry. The Patents Regulations 1986 and Patents Act 1983 govern patent protection. The Patents Act specifies twenty-years of protection period from the date of registration of an application according to Trade-Related Aspects of Intellectual Property Rights (TRIPS). The certificate of innovation offers ten years of protection from the date of registration of the request. It is renewable for two successive five years terms. Malaysian applicants may file a patent application directly, but a foreign application can only be filed with the support from a Malaysia legal patent agent. The patent owner has the right to allocate or conduct the patent, exploit the patented invention, and conclude a licensed contractor (The Official Portal of Intellectual Property Corporation of Malaysia [MyIPO], 2018). More patents generated with the differentiated product development, the better the innovation results of the R&D project. However, it is highly related to project funding. Alvarado-Vargas, Callaway, and Ariss (2017) claimed that fundings allocated for R&D projects, the more inventions and patents would be generated.

1.1.4 Organization Capabilities

Henri (2006) claimed that firm capabilities are the critical elements of the resource-based view (RBV). Firm capabilities in terms of management, technological, customer relationship management, and marketing capabilities, affect directly new product innovation performance, helping the firm to gain a competitive advantage, create

market change or market matching (Zawislak, Fracasso & Tello-Gamarra, 2018; Kamboj & Rahman, 2017; Sattayaraksa & Boon-itt, 2018; Valmohammadi, 2017).

The literature indicated the relationship between organizational capabilities and various NPD success measures (Akroush & Awwad, 2018). However, studies that examined the organization's capabilities effect on the E&E R&D project innovation performance, especially in Penang, Malaysia, is scant. The present study objective was to close the research gap and provide practical suggestions to manufacturing firms about the significance of developing the right strategy and organizational capabilities to strengthen their product development innovation capabilities. By doing so will likely help them to survive in a challenging market. Besides, job stability and economic growth in Penang Malaysia can be sustained as well.

1.2 Problem Statement

New Economic Model (NEM) as stated in the Tenth Malaysia Plan (10MP) was launched in March 2010. Its goal is to drive Malaysia into a high-income country through innovation and knowledge-based economy. In NEM, several programs have been implemented, such as the Economic Transformation Plan (ETP) and the Government Transformation Plan (GTP). To achieve such purposes, industries and companies have to be innovative and competitive at the global level. The private sector is the primary driver to transform the current economic activities into high productivity practices through innovation. In NEM, the government has introduced various methods of inventions in the private and public areas. These methods include the improvement of the educational system, R&D activities, and the addition of skilled human capital towards new economic growth.

MIDA (2019) is continually developing the ecosystem to fulfill the increasing demands for adopting Industry 4.0 in the E&E industry. The primary investment areas are flexible hybrid electronics (FHE) materials improvement, integrated packaging, and printing for sensor or device, thinned device processing, tools for system design and development, as well as reliability testing and modeling. The application of FHE is an exciting new area in the E&E sector as it inspires several new wearable electronics and industrial technologies. With FHE, manufacturing firms can produce smart products that are lightweight, flexible, and have a wide variety of applications at a reasonable cost. These include rugged sensors and health-monitoring wearables. Besides, MIDA is also collaborating with USAINS Holding Sdn. Bhd. on a talent development program to support the E&E industry innovation initiatives. It mainly focuses on cutting-edge engineering topics and innovation (MIDA, 2019).

According to Rasiah et al. (2015a, 2015b), the private industry involvement in R&D has increased significantly from 2005 onwards. However, Malaysia patent filing is pretty little if compared to other energetic Asian countries. For instance, 25 423 (Information and Communication (ICT) patents were filed in the United State of America (USA) by Koreans in comparison with merely 273 by Malaysians between 2006 and 2011. Even with the existence of multinational companies in Malaysia, R&D projects are not executed smoothly because of the inadequate R&D infrastructure support. The R&D infrastructure gaps are referring to the lack of competent human resources as well as laboratories at public institutions and universities (Rasiah, 2014; OECD, 2013).

According to Rasiah and Chandran (2017), the underperformance of high-technology manufacturing products and services development is a serious concern. There is less

value being brought to products than before even though the manufacturing volume has not reduced. Besides, Malaysia has been behind the high-technology export competition compared to other dynamic countries (Barrientos, 2020). Malaysia has been behind the high-technology export competition compared to other dynamic countries as illustrated in Figure 1.5. The high technology exports values are still very much lesser compared to Singapore, Korea and United States. Malaysia's manufacturing firms are not able to make a profit and survive for an extended period due to low R&D project innovation performance. The job reduction and unemployment issues are the critical issues that arise with the unsustainable or closure of manufacturing firms (Perkeso, 2019). These issues need to be addressed promptly as they affect economic growth and other social problems in Penang, Malaysia.

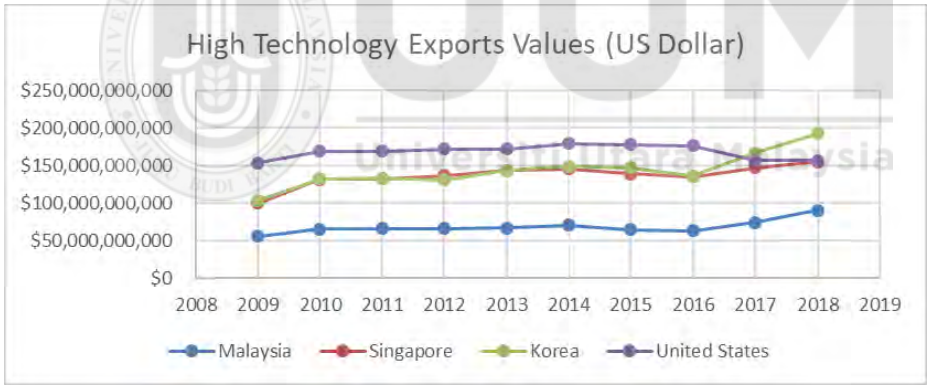

Figure 1.5
Country Comparison for High Technology Exports Values
Source: Barrientos, M. (2020).

The criticalness of firm capabilities in attaining and sustaining new product competitive advantage was highlighted by past research (Akroush, 2012; Pavlou & El Sawy, 2006; Matear et al., 2004). Firm capabilities as illustrated under the firm resource-based view is one of the factors to improve the competitive advantage of sustenance (Collis, 1994). The R&D project innovation performance degree is considered for the new product's competitive advantage (Akroush, 2012). All these

factors and reasons are the key motivators of the study to investigate Penang E&E manufacturing firms' organizational capabilities that could have a significant effect on the R&D project innovation performance for the firms' long-term sustainability and success in the challenging global market today.

1.2.1 Organization Technological Capabilities

According to Gonsen (2016), technological capabilities are the ability needed for existing technology improvement, adaptation, selection, or new technology creation. These technologies renew, or new invention activities require the capacity to use technical knowledge well. A firm's technological capabilities are the critical factor that contributes to the R&D project innovation and firm performance (Tzokas, Kim, Akbar, & Al-Dajani, 2015; Aminbeidokhti, Jamshidi, & Mohammadi Hoseini, 2016).

Some of E&E manufacturing organizations in Penang, however, do not possess R&D engineers and technicians with the right technical competencies to develop new products (Wong, 2017). Because of the demand for competent talent supply, MIDA is working with USAINS holding Sdn. Bhd., which is a subsidiary of USM to develop talents, especially in innovative engineering subjects (MIDA, 2019). Besides human resources, Penang E&E manufacturing firms may have difficulty to locate proper laboratories, facilities, or equipment to measure or test the original product. They have no choice but to search for external consultants or outsource the whole R&D projects to foreign firms in developed countries if their financial situation allows. This problem happens to the multinational companies established in Malaysia that active in the private-sector R&D as well. These multinational firms are highly dependent on their external Malaysia based parent or subsidiary companies for technical support due to the lack of capable human resources and university research support locally (Rasiah &

Chandran, 2017). Furthermore, the manufacturing firms may not have a breakthrough in their product development project due to the technical barrier restricted by competitor patent filing, and they find no way to work around them. It has caused the R&D project to either be delayed or canceled due to the technical roadblock encountered (Zhao, Xiang, & Yi, 2017).

Multiple local universities in Malaysia provide research and development support for the industry. Hence, manufacturing organizations may enjoy the benefit of collaboration with these higher education institutes, such as USM, to close their gap in technical competencies (Rasiah & Chandran, 2017). The organization and University R&D collaboration are likely to affect innovation of process. The innovation of product is positively influenced by the distance between the organization and a university (Maietta, 2015). For example, Universiti Sains Malaysia (USM) has an agreement with Agilent Technologies Malaysia through the Institute for Research in Molecular Medicine (INFORMM), paving the way for strategic collaboration that would lead to knowledge-based economic results. This collaborative effort between Agilent and USM targets to establish cooperation for future research activities and educational programs (Marziana, 2018).

1.2.2 Organization Marketing Capabilities

Marketing capabilities are an organization's capabilities to comprehend and predict customer requirements better than competitors (Krasnikov and Jayachandran, 2008). Marketing capabilities include marketing management research and marketing mix capabilities. Penang E&E manufacturing companies may not have the marketing experts in defining the product roadmap. They may do the wrong product demand estimation and set the wrong product market segment, leading to the wrong product

development direction given to the product development team, causing the developed product to fail in the market (Najafi-Tavani, Sharifi, & Najafi-Tavani, 2016). As a consequence, firms may lose their financial strength and capabilities to compete in the market. Sometimes, the firm's marketing team has difficulties in promoting or selling the product due to poor marketing and distribution strategy (Durst, Hinteregger, Temel, & Yesilay, 2018; Strand, Wiig, Torheim, Solli-Sæther, & Nesset, 2017). All these factors may lead to poor R&D innovation performance as there is no value to file any IPs for those market failure products due to the high IP filing costs. Furthermore, the marketing team needs to have the capabilities to do competitive analysis and define the right market strategy to win in the market (Info Entrepreneurs, n.d.).

1.2.3 Organization Customer Relationship Capabilities

Day and Van den Bulte (2002) defined organizational-customer relationship capabilities as the firm ability to establish strong, long-lasting relationships with present and future customers. Valmohammadi and Beladpas (2014) maintained that customer relationship management capabilities allow firms to search, attract, and improve retention of valuable customers by building a good relationship with them. Such capabilities are being practically used in both developing and developed nations. Firms need to have customer relationship management capabilities to track each customer or segment of customers and monitor their progress toward the purchase. Such customer capabilities are relied on founding strong, long-lasting relationships with existing and future clients.

It is vital to have the right customer support strategy to ensure a long-lasting relationship with them. By knowing the clients well, the organization can know their requirements well for the appropriate product development to suit their needs

(Valmohammadi, 2017). Sometimes, the organization may collaborate with its customers in developing new products (Ranjan & Read, 2016), reducing the risks of having unwanted products being developed. Furthermore, the R&D project team will have enough funding and confidence in creating new IPs for their project. It enhances R&D project innovation performance (Yang & Zhang, 2018).

1.2.4 Organization Management Capabilities

Zawislak, Alves, and Pacheco (2012) defined organization management capabilities as the ability to direct efforts to transform the company result in a comprehensible operational and transactional management. Management capabilities are needed to organize, plan, lead, and control resources in an organization for the achievement of its objective. The management team needs to create a secure and respectful working environment. Management capabilities was found to have a positive impact on both process and product innovation with gender variety in the senior management team as the moderator (Ruiz-Jiménez and del Mar Fuentes-Fuentes, 2016). Management capabilities with a balance in the number of women and men in the management team were found to have a more considerable impact on both product and process innovation.

For R&D project success, it is essential to have full support from the top management team regarding human resources and financial allocation. Without senior management support, most likely, the R&D project is delayed or terminated due to resource issues (Yang & Zhang, 2018). The management team must also equip themselves with the right competencies in coordinating internal departments for the R&D project execution and inter-department conflict resolution promptly (Darawong, 2018). A smooth R&D project execution encourages more creative and innovative ideas. Besides, the management team must define the right company policy and direction to grow the

internal R&D staff. It is also vital to provide a supportive environment for efficient and innovative R&D project execution, as well as organization performance improvement (Khosravi, Newton, & Rezvani, 2019).

Furthermore, the management team must follow up on the government policy and R&D incentive program closely, such as the MIDA R&D project grant. Manufacturing firms can get the government fund in developing a new product (MIDA,2019). Sharma, Paswan, Ambrammal, and Dhanora (2018) demonstrated that proper patent policy enforcement for longer protection duration and membership into an international agreement had a positive impact on the innovation of R&D activities. MyIPO has been working with key investors in the industry, particularly the financial institutions, to provide financing support based on local organization IP rights as part of the required collateral to secure loans. It is one of the government's plans to improve and boost domestic manufacturing firms' competitiveness (MyIPO, 2018). With substantial financial support, the R&D innovation project performance is enhanced as more IPs are generated.

According to the discussion above, organization-technological, customer relationship management, marketing capabilities, and management capabilities could exert a direct effect on R&D project innovation performance. However, research on such a relationship in the Penang E&E manufacturing organization remains limited. This research aimed at fulfilling such a gap.

1.3 Research Questions

Based on the above discussion, this study aimed to address the following research questions.

1. Do technological capabilities have a significant effect on R&D project innovation performance?

2. Do marketing capabilities have a significant effect on R&D project innovation performance?

3. Do customer relationship management capabilities have a significant effect on R&D project innovation performance?

4. Do management capabilities have a significant effect on R&D project innovation performance?

1.4 Research Objectives

Based on the research questions, four research objectives were formulated as follows:

1. To examine the effect of manufacturing firms' technological capabilities on R&D project innovation performance.

2. To determine the effect of manufacturing firms' marketing capabilities on R&D project innovation performance.

3. To identify the effect of manufacturing firms' customer relationship management capabilities on R&D project innovation performance.

4. To examine the effect of manufacturing firms' management capabilities on R&D project innovation performance.

1.5 Significance of the Study

The research results may apply to Penang E&E manufacturing firms' management team for their organizational capability enhancement. If the results are valid, they provide empirical evidence of the effect of firm capabilities on R&D project

innovation performance. Therefore, manufacturing firms can focus on improving the identified capabilities to innovate and develop differentiated products. The study will also encourage more patents generation and filing, which indirectly help strengthen Malaysia's position in the international competitiveness index and innovation index.

Secondly, more local and foreign direct investment may be attracted by the higher R&D project innovation performance and patent commercialization rate as investors acquire not only monetary return but also the technologies to improve its competitive advantages. Such an investment will help sustain R&D jobs in Penang E&E industry as well as economic and technological growth in Malaysia. The economic and technological growth is crucial for Penang as more than 95% of Penang Gross Domestic Product (GDP) is made up of manufacturing and services (Penang State Government Official Portal, 2018).

This study adds values to the theoretical knowledge of the R&D field in a few ways. First, the study improves the literature of R&D project innovation performance in the E&E sector, a context underlined as lacking in such field of research, especially in Malaysia. The literature indicates past research on the innovation effect on competitive advantage in the wood sector (Hassan, Yaacob, & Abdullatiff, 2014), hotel sector (Asree, Zain, & Razalli, 2010), and food industry (Aziz & Samad, 2016). However, studies on the relationship between organizational capabilities towards R&D project innovation performance in the E&E manufacturing firms are needed because this sector contributed 38.2% of the total exports of Malaysia in 2018 (FMT News, 2019). If valid, the study will also provide further support for the proposition that organization management capabilities affect new product competitive advantage in addition to technological, marketing, and customer relationship management capabilities, an issue

considered worthy of further examination (Akroush, 2012). The study also contributes further to the theoretical development in examining R&D project innovation performance as a different dimension of new service or product competitive advantages (Akroush, 2012).

1.6 Scope and Limitations

This study focused on Penang E&E manufacturing firms. A quantitative approach was applied to address the research questions and accomplish the research objectives. Three limitations of the present research could be identified. First of all, the research findings may not apply to other E&E manufacturing firms in other states in Malaysia because they may have a different R&D ecosystem and supporting technical human and financial resources. The second limitation is that it does not address the need for the service sector, which is vital to the economy of Malaysia. The third limitation is that this research focused on the innovation performance of R&D project only. Other R&D project success measurement dimensions, such as product quality, financial return and market expansion, which could help us understand more of the effects of organizational capabilities, were not considered.

1.7 Definition of Key Terms

i) R&D or research and development—R&D is the event a company undertakes to introduce and create new services and products. R&D happens typically in the first phase of the development process. The objective is usually to add new services and products to the company portfolio. Organizations grow with these improvements through R&D activities. (Kenton, 2019).

ii) Project—A project is defined as a piece of planned works or activities that are completed over time to achieve a specific objective with the limitation of costs, scopes and scope constraints (Abdomerovic & Blakemore, 2002; Project Management Institute [PMI], n.d.).

iii) Project performance—This is defined as the achievement of the project team in meeting the project objectives within the three primary constraints, which are time, budget, and scope (Spalek, 2014).

iv) Intellectual property—This is defined as mind creation, such as literary, inventions, names, pictures, artistic works, symbols, and designs used in business (WIPO, n.d.).

v) Patent— It is an authority grant of the invention incorporeal property right to an inventor to exercise the patented design, method, or creation in exchange for a complete disclosure of the discovery or invention within a given period. (Kenton, 2019).

vi) Innovation—It is defined as the benefits generated by the team during the innovation process, such as new ideas to improve the products, processes, procedures that increase the differentiation and competitiveness of the products (Osman, Shariff, & Lajin, 2016).

v) Innovation performance—It is the outcome of an organization's innovation efforts that improve its competitiveness, including intellectual property generation, such as a patent (Hurley & Hult, 1998).

vii) Organizational management capabilities—They are defined as the capabilities of the company's management team to make use of the strategic resource possessed by them to sustain and expand the business (Andersen, 2011).

viii) Technological capabilities—They are defined as an organization's production capabilities, R&D capabilities, technical complementarities, and design capabilities (Matear et al., 2004).

ix) Marketing capabilities—These are defined as marketing management, marketing mix, market research, and marketing complementarities capabilities (Verona, 1999).

x) Customer relationship capabilities—They are defined as the capability of the firm in building strong, long-lasting relationships with present and future clients (Day & Van den Bulte, 2002).

xi) Management capabilities—They are defined as the organization's ability to direct efforts to transform the result in a comprehensible operational and transactional management (Zawislak, Alves, & Pacheco, 2012).

xii) Manufacturing firms are defined as the establishments engaged in the physical, mechanical, chemical transformation of components, materials, or substances into new products, and those involved in assembling parts of manufactured products for purposes other than construction (Levinson, 2017).

1.8 Organization of the Thesis

There are five key chapters in this study, organized as follows:

The first chapter, Chapter 1, is an introductory chapter where the background of the study and the research problem are discussed, followed by the illustration of the research questions, research objectives, the significance of the research, the scope and limitation of the study. This chapter ends with the definitions of key terms used.

Chapter 2 assesses the supporting literature of resource-based view and innovation theories that underpin the study. A detailed survey of the relevant literature is presented, particularly one that is related to the effect of organizational capability on R&D project innovation performance.

Chapter 3 discusses the research methodology and research execution plan. The population and sample of participants, the data collection method, the survey validation, and the method of analysis are elaborated in this chapter. The pilot test is part of the execution plan for this study.

Chapter 4 demonstrates the results of the data analysis, as well as a discussion of the results in relation to the theory and literature. Research conclusions are also discussed in this chapter.

Chapter 5 presents the practical and theoretical implications of the study. It also highlights the limitations of the study and offers directions for future research. Some remarks about the study conclude this chapter.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter provides an in-depth literature review relevant to the study. Section 2.1 describes the innovation performance of R&D project. Section 2.2 and 2.3 offer an overview of the E&E industry of Malaysia and Penang, respectively. Section 2.4 to 2.7 reviews the literature related to technological, marketing, customer relationship management, and management capabilities of an organization. Section 2.8 offers critical literature on the relevant theories underpinning the study. These theories are resource-based review and innovation theory. Section 2.9 hypothesizes the relationship between the organizational capabilities and R&D project innovation performance. Section 2.10 concludes this chapter.

2.1 R&D Project Innovation Performance

Innovation is an important factor for a country's economic growth performance. It also contributes to organizations' business-related sustainability and success in a challenging market (Corrocher & Solito, 2017; Strobel & Kratzer, 2017). It is the vital driving force for the success of a nation and corporate organizations in the rapidly changing business environment, characterized with high customer expectations and requirements, business and technologies competition, and short product life cycle (Mawson & Brown, 2017; Zou et al., 2017; Woschke et al., 2017). Besides, innovation fulfills the needs or requirements of all levels of society—individual, organization, or country. SME manufacturing firms innovate to improve their productivity and subsequently enhance their financial performance (Beard, Madden, & Azam, 2014).

Various definitions of an organization's R&D innovation capabilities are available in the literature. Stoker and Van der Heijden (2001) defined innovation as a new practice or idea adopted by an organization. Edwards, Kumar, and Ranjan (2002) claimed that innovation is a new creation, knowledge, and idea application of the design and management series processes. According to West (2004), innovation is the new process an organization has learned and deployed, as well as the product design and development in the manufacturing systems. Besides, Pittaway et al. (2004) stated that innovation is the successful application of new processes, services, products, or business practice ideas. They stressed that innovation reduces an organization's productivity gap in terms of performance and growth in business goals.

According to Flor and Oltra (2004), an innovative firm is a firm that has implemented technological improvements in products and processes. The implementation implies a series of activities in the innovation process carried out successfully in the company. Simmie (2005) defined innovation performance as the achievement of new concepts, approaches, and knowledge application introduced to improve the existing processes and products. Innovation is a result of a collaborative knowledge study process that involves the use of internal and external organization's talents frequently. Innovation is part of the strategic plan developed by business leaders in managing the fast-changing commercial environment and challenges (Bloodgood, Turnley, & Bauerschmidt, 2007). Innovation does not only refer to original product design and development, but it also includes creative management methods and customer presentations beyond customer expectations (Lale & Arzu, 2009). In terms of corporate innovation, technological innovation is required to develop original or improved products or services with the new method in a shorter timeframe and cheaper

costs. It also includes new market development with breakthrough ways of sales, marketing, and channels of distribution (Deshati, 2016; Osman et al., 2016).

Due to its significance, innovation is a business management research topic that receives much scholarly attention because it is a critical factor for the sustainability of many industries and business corporations. The improved or new services or products, the firm's management style, and method, are critical corporate competitive success factors (Stampfl, 2016; Taneja et al., 2016). Hence, industry leaders recognize innovation as their top concerns and priorities (Scantlegury & Lawton, 2007). Indeed, top management support and company strategy, are essential for the firm's product innovation performance (Zhao, Xiang, & Yi, 2017; Krig & Sandra, 2017). Innovation capabilities were enhanced as a result of leaders with proactive entrepreneurial orientation (Liu, Ko, Ngugi, & Takeda, 2017). Sattayaraksa and Boon-itt (2018) also demonstrated that a chief executive officer with a transformational type of leadership could enhance organizational learning, culture, and innovation strategy.

Many past studies have demonstrated that innovation could contribute positively to company performance, which is measured by economic development (Camison & Villar-Lopez, 2014; Guan & Yam, 2015). Maldonado-Guzmán, Garza-Reyes, Pinzon-Castro, and Kumar (2019) found a significant and positive effect of products, processes, marketing, and management innovation on the business return of SMEs in Mexico. They concluded that SMEs gained many benefits from product development, management, and marketing innovation capabilities, one of which was increased commercial performance. The positive and significant impact of innovation capabilities on the business performance they found was in line with the result of Kafetzopoulos and Psomas (2015) and Hilman and Kaliappen (2015). Valmohammadi

(2017) showed that the improvement of product innovation resulted from customer relationship management increased company performance. Nuryakin (2018) also reported a similar result. He found that the innovation of products had a significant effect on the competitive advantage, as well as the marketing performance of companies under study. He further revealed that market orientation had a significant influence on product innovation, which affected the competitive product advantage and marketing performance.

According to Kafetzopoulos and Psomas (2015), "innovation capability" provides opportunities for organizations to improve their performance as innovation capability was found directly contributed to the quality of product and the firm operational performance. Therefore, innovation must be the critical focus of management teams in driving for business performance in long-term success, competitiveness, and sustainability. Rajapathirana and Hui (2018) showed that innovation capabilities and innovation efforts had a significant relationship with organizational performance. To further improve the diffusion level of knowledge (absorptive knowledge) and innovation activities, companies are encouraged to undertake, accept, and adopt innovations from various sources, such as through the necessary high technology equipment and software purchase and update, R&D acquisition externally, internal firm R&D, and external or internal training (Liao, Fei, & Chen, 2007). Innovation capabilities were found to improve the financial and market performance of corporate organizations because the capabilities were shown to affect positively external collaboration (Wang, Dou, Zhu, & Zhou, 2015). One source of innovation is local universities that are active in R&D activities; hence, companies are encouraged to increase their innovation activities by collaborating with universities to enhance project innovation performance (Rasiah & Chandran, 2017).

Dysfunctional competition, which is the result of intellectual property rights violations, has caused no or less profit gain by innovators in developing nations. Therefore, in developing countries, organizations need rightful strategies to overcome the problem. Breakthrough marketing, strong customer focus business orientation, and low-cost initiatives yield better competitive advantage and innovation performance in dealing with dysfunctional competition (Liu & Atuahene-Gima, 2018).

Akhtar, Ismail, Ndaliman, Hussain & Haider (2015) revealed that intellectual capital was essential for SME sustenance. The result is consistent with past studies that demonstrated intellectual capital as the most significant intangible asset for firm growth. It is critical to promote product development innovation for NPD project success. It is also vital to have patent acquisition and protection for a company to sustain and compete in the current challenging commercial environment. According to Zhao, Xiang, and Yi (2017), patent attainment and protection had a significant effect on firm innovation achievement as well as patent commercialization. A firm's knowledge resources, strategic capabilities, R&D application, fundamental research, and manufacturing capabilities should impact positively on the NPD performance and the competitiveness of the product (Liu & Jiang, 2016). Krig and Sandra (2017) found that senior leadership participants in intellectual property strategy development, especially in aligning their intellectual property strategy with business strategy, contributed to better intellectual property performance in companies. As part of overall business strategy, IP strategy increased resource efficiency, innovativeness, higher quantity or quality, and active use of a higher fraction of IP assets.

There is still no good R&D investment return, while R&D and patenting are essential for Malaysia's export-oriented development and competitiveness strategy (Chandran

& Wong, 2011). According to WIPO (n.d.), Malaysia's patent application rate with the patent office has grown consistently over the years (8236 in 2018) but it is still far behind from dynamics countries like the Republic of Korea (133,141 in 2018). Besides, Malaysia observed low domestic application quality, 1,116 compared to 6,179 for non-resident applicants in 2018. Furthermore, public research organizations or academics in Malaysia have challenges to enable their research into intellectual property rights. Even it is strongly stressed on pre-commercialization and commercialization in the Ninth Malaysia Plan (2006–2010), there is no fruitful return on R&D investment (Thiruchelvam et al., 2011). This under par commercialization rate is mainly due to the research firms' rigidities, issues with coordinating policies and poor collaboration between industry-university. The local universities also tend to restrain their research results commercialization to specific fields, such as ICTs and health (Rasiah& Chandran, 2017).

The government of Malaysia is actively pursuing the increased transfer of technologies and technology commercialization activities from universities to the industry, such as through the National Innovation Agency Malaysia (AIM), MyIPO, and Malaysian Foundation for Innovation (YIM). Centers for innovation and commercialization are established in universities to drive innovation and commercialization activities from universities to companies (Akhtar, Ismail, Ndaliman, & Hussain, 2015). Sharma et al. (2018) highlighted that good government patent policy changes had a positive effect on R&D focus and investment. The continuous investment in R&D enhances organizational survivability. In other words, sustainable development offers a chance to improve growth and competitiveness, as it becomes a source of inspiration for innovative activities through internal training to staff (Ketata, Sofka & Grimpe, 2015).

Organizations have to reinforce R&D investments for continuous innovation discoveries to have a competitive advantage in the fierce competition and challenging business environment (Prajogo & Oke, 2016; Simao, Rodrigues, & Madeira, 2016). However, firms have a mixed track record of business success despite the massive R&D investment and the incremental number of high potential and motivated entrepreneurial managers (Drake, Sakkab, & Jonash, 2006). The majority of firms have failed to sustain, and even the winner firms could lose their approach to innovation that made them great in the first place (Chandrasekar, 2006). Some suggest that firms incline to see innovation low success rate processes that could be continuously enhanced to achieve and sustain business success. Genc and Di Benedetto (2015) found that collaboration of R&D, marketing, manufacturing, and environmental specialist could improve sustainable new product development performance, which resulted in good economics sustainability. Hence, this study was an attempt to offer facts of the role of organizational capabilities in influencing innovation.

Many variables have been studied as factors affecting innovation capabilities. The internal firms' technological problems surface when the consumer markets become more significant. Most of the time, organizations require new organizational models to overcome the lack of resources to execute innovation activities. A new organization model with high skills and expertise resources are needed for sophisticated product development and manufacturing. There are individual, organizational, and environmental factors contributing to innovation performance in general (Zennouche, Zhang, & Wang, 2014). This study focused on the organizational factors that are probable to influence the most on the performance of innovation activities based on

the literature, such as technological, marketing, customer relationship management, and management capabilities.

2.2 Malaysia Electronics and Electrical Industry

Malaysia is a politically stable nation, supported by a complete lawful system with pro-business and market-oriented economy government policies. The productive workforce and a well-established infrastructure designed to serve the business community are Malaysia's key business strengths and advantage. Malaysia emphasizes workforce skills development for a non-stop supply of human resources to support the growing services and manufacturing sectors (MIDA,2019). The workforce here is young but highly trained and productive. In terms of infrastructure, there are fiber optic and digital technology telecommunications, well-maintained highways, seven global level seaports, and five air-cargo amenities equipped with international airports. Malaysia also provides excellent incentives to attract investors (MIDA, 2019).

Besides, Malaysia is one of the most technologically developed countries amongst the industrializing nations in the Association of Southeast Asian Nations (ASEAN) region. There are more than five hundred export processing industrial parks, and the free trade zones established all over the country to fulfill the demand of the export-oriented sectors. Malaysia is actively involved in high tech and automated electronics, biotechnology, photonics R&D, logistics, and manufacturing activities. Malaysia has become the center for R&D, marketing, distribution and marketing procurement, logistics, and business support services of value chain activities (MIDA, 2019).

The infrastructures provide a cost-effective site for investors aiming to set up cutting-edge technological products manufacturing for local and global level markets in a foreign country. According to MIDA (2019), Malaysia had attracted more than five thousand overseas corporations from more than forty nations to start their business here. Besides, many of the foreign companies have also diversified and expanded their services and activities in Malaysia, signifying strong evidence of the confidence foreign investors have in Malaysia as their corporate venture location. Among the investments, the E&E industry has exceeded 1,695 corporations with an overall investment of RM108 billion and the employment of 600,000 people.

The E&E industry started in 1972 from labor-intensive semiconductor assembly to test manufacturing and diversified into storage, LEDs, solar, contract manufacturing, medical devices, industrial electronics, avionics, front-end fab, as well as design and developments, especially in both integrated circuits (ICs) and embedded system designs. As the E&E industry grows and diversifies, it has also developed clusters of SMEs and large local companies in precision machining, equipment development and assembly, and automation. Many such companies are doing business globally, and many are also listed on Bursa Malaysia. That Malaysia gains recognition as one of the choicest industry cluster locations in the world has been a clear reflection of the comparative advantage Malaysia has over the neighboring countries, in terms of its part in global E&E. In terms of the E&E-friendly policy, tax incentives were introduced by the Malaysian government to encourage value-added in the local E&E sector. There is a tax exemption for up to 10 years for those E&E firms that capitalize on knowledge-based amenities. Furthermore, there is an exclusive investment grant given to those E&E firms with the expired reinvestment allowance.

According to MATRADE (2019), E&E continued to be the most significant exports from 2015 till 2018, with a total product export amount of RM1289.54 billion. Figure 2.1 illustrates that the E&E product export values rose from RM277.92 billion in 2015 to RM380.81 billion in 2018. In 2018, 721 manufacturing projects were approved, with RM87,375.6 million investments, adding 59,294 job opportunities in the country. The E&E industry had an investment share of 12.8% (RM11,179.6 million) from the total investment (MIDA, 2018).

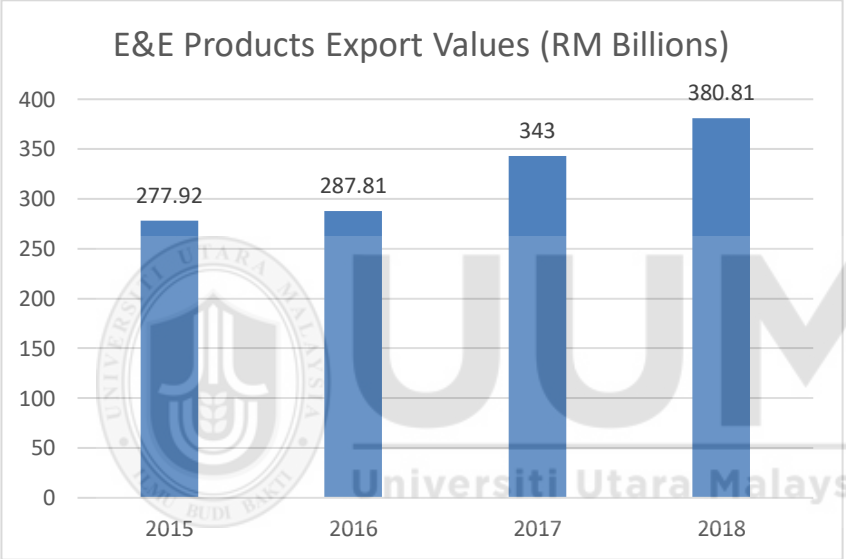

Figure 2.1 2015-2018 E&E Products Export Values
Source: Malaysia External Trade Development Corporation (MATRADE), 2019.

2.3 Penang Electronics and Electrical Industry

Penang is one of the most dynamic, progressive, and competitive states of Malaysia. It is one of the ten active international industrial locations that has established a fruitful manufacturing experience among the developing nations (UNIDO, 2009). The existence of forty years of a robust and reliable supply chain with competitive capabilities supporting their investors well is the major success factor of Penang. Its excellent experience provides good operational returns to investors, such as faster product development and learning cycles, that have minimized time and cost to market.

Penang is supported by a network of over three thousand diversified and capable local dealers. The local suppliers provide various electronic components, lead frames, metalwork, precision plastics, and tooling engineering, vision check, test handlers, and product assembly, packaging, and test services. Besides, there are many good software developers providing software services and products, such as Human Resource Management (HRM) and Enterprise Resource Planning (ERP) (Invest Penang, 2019).

There are one hundred and eight manufacturing pro-local electronic manufacturing services (EMS) companies. Vitrox is one of them. It manufactures and services innovative automated low cost, cutting-edge, and vision check equipment for the semiconductor industries. Inari Technology is another local company that provides back-end wafer manufacturing, semiconductor assembly, and final radio frequency testing for its customers. In short, Penang remains to have a strong presence of MNCs and large local corporations (LLCs) since the 1970s. Penang has consistently ranked among the highest investment destinations in the country over the last five decades. Companies, such as Intel Technology, Jabil Circuits, WD Media (Malaysia), HP Malaysia, Vitrox Technologies, Inari Group, Southern Steel, B Braun Medical Industries, Osram Opto Semiconductor, and DSEM System Technology, hold much promise for commercial collaborations and opportunities (Invest Penang, 2019).

MIDA (2018) approved a total of 4,084 manufacturing projects, with investments worth RM 29 billion for Penang as of 2018. These projects generated over 516,600 job opportunities, mostly in electrical and electronics products, primary metal products, scientific measuring equipment, machinery equipment, and transport equipment. Officially approved foreign investments in the manufacturing sector totaled RM90.4

billion, accounting for 70% of total approved investments for Penang, while local investments constituted the remaining 30% or RM38.7 billion.

2.4 Technological Capabilities

Technological capabilities are a firm's capabilities to execute its technological function. It includes new products, methods, and technical know-how development for corporate efficiency improvement (Tsai, 2004). In more detail, technological capabilities are a firm's gathering of technical information that enables new product development or existing product improvement (Kylaheiko, Jantunen, Puumalainen, Saarenketo & Tuppura, 2011). It comprises organizational learning, product development and manufacturing, technological complementarities, and design capabilities. Organizational learning capabilities were known having a significant positive effect on corporate innovation (Aminbeidokhti et al., 2016).

Tzokas et al. (2015) demonstrated that an organization's technological capabilities had a significant impact on its absorptive capacity and performance. Mozaheb, Alamolhodaei, and Ardakani (2015) showed that SMEs technological capabilities had a positive relationship with exporting companies. Besides, Okwemba (2018) found that technological capabilities had a positive impact on Kenya manufacturing firms' performance. De Almeida Guerra and Camargo (2016) revealed that technological capability was a crucial factor for economic growth because it facilitated corporate globalization and provided new product success. Radzi, Shamsuddin and Wahab (2017) highlighted that SMEs' technological capabilities had a significant positive effect on the market competition with others, growth of innovation process in responding to market changes, innovative product development, firm performance enhancement, and the awareness of technological capabilities' roles and responsibilities improvement.

The firm's R&D and its application capabilities had a critical effect on NPD competitiveness and performance. Besides, marketing and technological capabilities interaction results were positively related to organizational performance (Liu & Jiang, 2016). However, Ali and Matsuno (2018) found that technological capabilities did not mediate the marketing and R&D integration effect on organizational performance. Most of these findings support the positive influence of technological capabilities on organizational performance, as well as innovative abilities for better product competitiveness.

Reichert, Zawislak, and Arundel (2016) demonstrated that low-technology firms had excellent innovation performance when their innovation capability was high. Low-technology firms are firms that invest not more than 1% of their revenue on R&D activities (Alexander, 2014). The performance of innovation capability does not depend on the strength of technological capabilities solely; it could be strengthened from the combination of transaction and management capabilities or transaction and development capabilities. The transactional capability is the range of abilities, experiences, skills, processes, routines, and knowledge the organization uses to reduce its transaction costs (Tello-Gamarra & Zawislak, 2013). The combination of transaction and management capabilities could lead to patent innovation with a substantial consideration of supplier and buyer requirements in developing a product. By the way, the complementaries of transaction and development capabilities could lead to a design patent that focuses on market needs in product development. Hence, low-technology firms are advised to improve the transaction, product development, and management capabilities if they want to have a breakthrough in their non-innovation situation (Zawislak et al., 2018).

Besides, the competitive achievement in knowledge-based and high-technology industrial markets is the result of consistent technological creation and development because a corporation could not effectively innovate by itself. Consequently, organizations should work with external networks and relationships to strengthen their technical know-how for more improvement and quicker innovation developments (Martín-de Castro, 2015). Zawislak, Schaeffer, Reichert, and Ruffoni (2015) argued about the differences in innovation capabilities of organizations that collaborate from those that do not collaborate with research and scientific institutes. Companies with collaborations have more operations, management, development, and transaction capabilities. The strength level of the capabilities of these two groups of companies is significantly different. Interacting organizations also have better innovative performance, measured by their profit, market share, and revenue growth. Najafi-Tavani, Naudé, Oghazi, & Zeynaloo (2018) showed that the interaction with scientific and research institutes did not only improve companies' development capability, but it also enabled them to gain profit.

Dynamic capability in terms of technological innovation with knowledge as a base is important for a firm's sustainable and competitive advantage improvement in high technology industries. However, Wu (2014) revealed that technological capabilities and collaboration with research institutes or universities had a moderate but negative effect on successful product innovation. They also pointed out that collaboration with competitors had an inverted U-shaped relationship with successful product innovations. There was a negative effect on the innovation performance of the product when too much collaboration with competitors due to competitors' opportunistic behavior. Furthermore, Ahmadi and O'Cass (2018) stressed that the promotion of R&D-

marketing capability complementarity and cross-functional collaboration through entrepreneurial posture could enhance the product advantage indirectly.

2.5 Marketing Capabilities

Aggressive and competitive business environments drive for more new product development based on market orientation. Strong market-oriented corporations, which have sufficient resources pool support, good cross-functional collaboration, and high NPD efficiency, are most probably to have better performance in new product design (Hong, Song, & Yoo, 2013). Krasnikov et al. (2008) defined marketing capabilities as a firm's marketing management, marketing research, marketing mix, and complementary skills to understand and meet customers' requirements better. Mu (2015) and Sulistyo (2016) demonstrated that marketing capabilities had a positive relationship with firm performance and innovation capability, and the firm performance had a positive effect on competitive advantage. Ren, Eisingerich & Tsai (2015) showed that the positive impact of R&D capability on innovation performance was enhanced by marketing capability.

Global high-tech firm marketing capabilities were known having a positive relationship with competitive strategy (Martin, Javalgi, & Cavusgil, 2017). Durst et al. (2018) showed that marketing capabilities had a positive relationship with the new product commercialization in both international and domestic markets. Strand et al. (2017) also found a similar result in that manufacturing, marketing, and organizational capabilities had a positive relationship with organization performance. Mozaheb et al. (2015) also published a similar result. They showed that market support was one of the variables contributing significantly to the performance of companies. Alharbi (2015) found higher success potential in firms operating in both international and local

markets that had marketing capabilities. Akroush and Awwad (2018) revealed that NPD marketing performance had a significant positive effect on the firms' financial performance.

Najafi-Tavani et al. (2016) found that market orientation and marketing capability had a positive relationship with NPD performance. Market orientation had a significant and positive relationship with innovation, which mediated the relationship between market orientation and business performance (Mahmoud, Blankson, Owusu-Frimpong, Nwankwo, & Trang, 2016). Nuryakin (2018) also revealed that marketing capabilities had a significant influence on marketing performance. They also found that the direction of the market had a positive effect on innovation of product. Zhou, Wu, and Barnes (2012) showed that an organization's marketing capabilities could be enhanced by early foreign market entry, which in turn supported the growth of the global business. They also revealed that new companies with a high commitment of senior management to international markets yielded improved marketing capabilities. However, Octavia and Ali (2017) had found that market orientation had no significant impact on organizational performance.

Theoretically, investment in marketing and innovation capabilities would enable firms to enhance themselves and compete in dynamic markets. Hence, the management team should focus on the integration of innovation and marketing capabilities because there is no significant firm performance improvement by individual capabilities alone (Jeng & Pak, 2016). Cacciolatti and Lee (2016) found improvement in marketing and product innovation resource capabilities, and their interaction had a significant impact on firms' financial performance through customer performance and innovation of the product. Besides, the interaction result between marketing and technological

capabilities was positively related to organizational performance (Liu & Jiang, 2016). Huang, Dyerson, Wu, and Harindranath (2015) found that firms with a better market status could only achieve a short-term competitive advantage, but strong technological capabilities could enable firms to yield a long-term sustainable competitive advantage. Therefore, firms could utilize the competitive advantage of their temporary market position to improve their technical capabilities to enhance competitive advantage in long run.

Arunachalam et al. (2018) found that expert level of marketing capabilities enhanced the impact of innovation results on profits, while architectural marketing capabilities strengthened the relationship between entrepreneurial orientation (EO) and innovation. Architectural marketing capabilities are the export market information gathering, analysis, and distribution process for venture marketing strategies development and decision making. The organizational performance was found to be positively influenced by innovation achievement. Furthermore, Snell and Sok (2015) showed that marketing resources mediated the relationship between EO and organization performance. The mediated relationship was more significant when having higher marketing resources in quantity than when they were lower.

2.6 Customer Relationship Management Capabilities

The literature related to customer engagement study is increasing. Customers are actively involved in the product value creation through innovation by having a stronger relationship with companies due to the internet (Fernandes & Remelhe, 2016). Valmohammadi and Beladpas (2014) defined customer relationship management as organization capabilities to detect, get interested, and prolong the holding of valuable customers. Customer relationship management capabilities are crucial in getting

dynamic customer feedback and fulfilling their requirements in social exchange. Firms have to prepare a mutual communication channel with customers for better interaction results (Bonsu & Darmody, 2008). A firm's customer relationship capabilities were found to have a positive effect on firm performance (Tzokas et al., 2015). Many past studies related to the collaboration with customers on design, production, relationship marketing, and product value development have been published in the marketing literature (Ranjan & Read, 2016). Customers are the critical asset for value creation with their direct or indirect involvement in these development activities (Tapscott & Williams, 2006). There are relational benefits and future commercial chances with the participation of customers in the process of value creation (O'Cass & Ngo, 2012).

Svendsen, Haugland, Grønhaug, and Hammervoll (2011) revealed that specific investments dedicated to the customer relationship, competitor orientation, product differentiation, and marketing strategy positively impacted customer involvement, which increased profitability from the customer. Nguyen, Phan, and Matsui (2018) showed that customer involvement had a positive relationship with the performance and success of NPD. Yang and Zhang (2018) also claimed that customer communication, engagement and focus had a significant positive effect on non-financial and financial NPD performance. Mozaheb et al. (2015) also revealed that excellent customer support and customer relationship management had positive effects on SME NPD performance. Homburg, Jozic, and Kuehnl (2017) found that customer experience management was the cultivation of mindsets to improve customer experiences. Customer experience management involves designing capabilities to enhance customer experiences continually. Customer relationship management's main objective is to attain and sustain customer loyalty in the long term.

Wang and Sengupta (2016) research found that the quality of customer relations had a significant impact on brand equity, which had a positive relationship with organization performance. Brand equity is the business value of having a well-established and famous brand name for more revenue generation due to customer trust in the product brand (Ailawadi, Lehmann, & Neslin, 2003). Zhang, Liang, and Wang (2016) found that the innovativeness of product was influenced by customer value anticipation. Besides, both purposeful and emotive advertising moderated the relationship between the innovativeness of the product and the lifetime value of the customer. Fidel, Schlesinger, and Cervera (2015) found that openness to innovation and collaboration with customers were critical inputs because of their effect on marketing and customer knowledge management outcomes.

On the other hand, the freed up resources by the termination of business relationships with a customer should be reused by the organization effectively as they affect product innovation activities positively. Zaefarian, Forkmann, Mitręga, and Henneberg (2017) had found that relationship-ending capabilities would enable organizations to explore new or reinforce the existing collaborative business relationships by using the free resources, positively affecting corporate innovativeness. They further showed that the corporate culture of accepting relationship terminations improved relationship-ending capabilities. Brondoni (2015) stressed that customer empowerment research exploited the chance of having innovative and creative simulated products to satisfy specific demand bubbles to avoid oversupply competition that caused unstable demand and supply structures due to excessive manufacturing.

International corporations have transformed customer engagement operations through cloud computing, mobile, and computer intelligent based business system to meet their

clients' expectations and improve customer experience, according to the 2012 IBM smarter commerce global summit report. Such technology enables online communities for mutual communication with customers, which help new product co-innovation, co-design, and co-development (Bugshan, 2015). Corporations have started to adopt social media progressively to deliver excellent customer experience through an innovative customer engagement system. Social media creativities of an organization enable mutual information sharing and collaboration across and within organizations for operational efficiency, innovativeness, and firm-customer interaction enhancement (Lam, Yeung, & Cheng, 2016). Social customer relationship management capability was found to improve customer engagement and firm performance when corporate organizations adopted social media as part of their marketing strategies (Wang & Kim, 2017).

2.7 Management Capabilities

Organizations attempt to gain a competitive advantage by improving their innovation capabilities. Managerial innovation becomes more prevalent in practice and research due to its positive impacts on organizational performance and renewal (Prasad & Junni, 2016; Charterina et al., 2017). Managerial innovation was positively related to firms' overall performance (Khosravi et al., 2019). Zawislak, Alves, and Pacheco (2012) defined management capabilities as the coordination capabilities to transform the technical outcome into an understandable way of working and transactional process management. Its priority is to uphold flawless information and production to achieve a better efficiency rate and, thus, strategic aims. It allows the firm to deal with unpredictable circumstances by using a range of skills, practices, and techniques to solve problems and take action when technology fails to be perfectly routinized.

Managers play entrepreneurial and leadership roles to detect opportunities, develop and apply practical business structures, develop capabilities, lead and transform the organization whenever necessary.

These entrepreneurial management responsibilities are part of the corporate capabilities, which include the processes that could be hard for transformation (Teece, 2016). Dynamic capabilities administrate the integration of an organization's internal and external competences, builds, and reconfigures to address uncertain commercial situations (Teece, Pisano, & Shuen, 1997). Managerial and organizational competencies are needed to sense the situation and create commercial models to tackle opportunities and threats. Therefore, dynamic capabilities are demonstrated in a business model innovation and application, the supportive culture and learning of the company, and the entrepreneurial ability of a senior management team. They are good for customers but appear to be threats to competitors.

According to Leih, Linden, and Teece (2015), a firm's structure, incentives, and culture should be matched to detect new business opportunities and, the application of a new model is important for the firm's dynamic capabilities. The new business model development must balance technological possibilities, and customer needs consistent with the main logic of the organization. Teece, Peteraf, and Leih (2016) concluded that an organization needs to have strong dynamic capabilities to address high business uncertainties, especially in countries undergoing frequent technological transformation and financial disruption. Lin, Su, and Higgins (2016) stated that dynamic capabilities had a significant positive influence on management adoptive innovation process from the beginning to the application stages. Wu, Chen, and Jiao

(2016) demonstrated that a firm's dynamic capabilities in sensing and capitalizing opportunities mediated international diversification and firm innovation performance.

According to Keller (2017), with a higher purpose sense, corporations were found to achieve better innovation, transformation, and profitability performance. Companies that were in the prioritizes category could connect their purpose with innovation compared to companies in the developers and laggards categories. The prioritizes categories of companies could attain better strategy advancement and business model evolution results. Anwar (2018) found that a business model innovation had a positive effect on SMEs' competitive advantage and financial performance. The core duty and responsibilities of entrepreneur managers were to detect the requirements for a business model change, revamp new business models, lead and manage the company's resources for organization transformation (Teece, 2007). Strategy development is part of the senior management team's responsibilities, and it is usually stated as the firm's dynamic capabilities. It was found to have a significant relationship with the degree of business model innovation and corporate performance (Liu, Wang, & Li, 2017).

Wang and Dass (2017) found that firm innovation was enhanced when the senior management team was involved directly in the exploration of innovation methods. According to Yang and Zhang (2018), top management support was shown to positively moderate the relationship between multiple dimensions of customer orientation and NPD performance. Durst et al. (2018) found leadership has a strong relationship with the commercialization of the original product in the market. They showed that the initiating leadership style encouraged the introduction of new managerial systems. Similarly, Su and Baird (2018) found that management innovation performance was strongly influenced by leadership style.

Regarding leadership style, entrepreneurship and entrepreneurial training orientation had a significant positive relationship with market performance (Octavia & Ali, 2017; Liu et al., 2017). With entrepreneurship orientation, faster innovation could result in new venture performance and a higher survival rate due to the improvement of the firms' innovativeness (Shan, Song, & Ju, 2016). Sattayaraksa and Boon-itt (2018) also found a positive relationship between CEO transformational leadership, culture, organizational learning, and innovation strategy.

On other management capabilities, knowledge management was found to mediate the positive relationship between corporate innovation, strategic direction, and firm performance (Kasemsap, 2017). Kafetzopoulos, Gotzamani, and Gkana (2015) demonstrated that quality management directly contributed to the innovation of product and process innovation, which had a strong impact on the competitive advantage of the firm. They recommended that firms should take the opportunity to improve their competitive advantage and innovation performance through quality management. On project management, Darawong (2018) revealed that learning and integrating capabilities of new product development project teams had a positive relationship with project effectiveness and efficiency. The project management success rate was even higher with the improvement of the collaboration.

2.8 Theories Underpinning the Study

The resource-based theory was the theory that guided the present study in investigating the effect of organization technological, customer relationship management, marketing, and management capabilities on the R&D project innovation performance of Penang E&E manufacturing firms. Consistent with the theory, firms' specific resources and their link to enhanced performance are explored in this section.

Resources are defined as all information, knowledge, assets, processes of the corporation, and capabilities managed by an organization to execute strategies to improve the performance of an organization (Barney, 1991). The identification and classification of an organization's resources are valuable because the effective utilization of resources could develop the competitive capability of the firm. Barney (1991) proposed three classifications of resources. They are human, physical, and organization capital resources. Mills, Platts, and Bourne (2003) expanded the classification of resources into six categories. They are system and process, experience and skills resources, knowledge resources, potential dynamic capability resources, tangible resources, cultural resources, and lastly, the values and network resources. Resources utilized to develop distinctive capabilities must be non-imitable, valuable, rare, non-substitutable, and non-transferable (Barney, 1991). Firms that acquire and develop resources to handle the dynamic external environment would generate value-creating first-mover advantage if the capabilities and attributes of the resources are consistent with Barney's inferences.

A resource-based theory underpinned this study as it speculates the connection between the management of talent resource and competitive advantage of an organization, and hence, a positive performance outcome to the organization over time (Rabbi, Ahad, Kousar, & Ali, 2015). This theory, which is based on talent management, postulates that talent is the only resource that primarily provides a sustainable competitive advantage basic. Therefore, organizations should focus on the expertise and capabilities derived from such talent. Based on Edith Penrose's resource-based theory, the performance differences between the same industry organizations, which could be accredited to the variances in the organization's capabilities and resources (Roos, Bainbridge, & Jacobsen, 2001). Galbreath and Galvin (2006) pointed out that

internal intangible resources, such as corporate talent, are more critical than tangible resources in developing and sustaining a competitive advantage, which could influence the competitive position of the organization. Talented employees are the only resource that could help organizations sustain a competitive advantage. Therefore, firms must put a focus on recruiting, developing, and retaining their talented workforce (Rabbi, 2015).

Festing and Eidems (2011) argued that the processes of supporting talent development have to be understood to contribute toward achieving a competitive advantage. A clear career development path is required for talents to be more accountable for the organization's future needs. Learning and development of the organizational talent workforce become necessary for businesses operating in a fast-paced business environment. As a result, organizations could acquire new skills and techniques to stay competitive in the industry.

In managing knowledge talent retention for competitive advantage sustenance, firms have to engage their employees in a viable organizational environment (Acharya & Jena, 2016) and react to such employees' needs (Osaro, 2016). The primary objective of managing the retention of talent is to avoid the loss of competitive advantage of a company that could benefit the competitors. The success of managing talent retention by developing appropriate mechanisms, such as rewards, autonomy, and image, contributes to a company's competitive advantage (Al-Damoe, Yazam, & Ahmid, 2012). A lack of commitment and dissatisfaction among the talented workforce could trigger them to leave the company. As a result, the company would be at risk of losing its competitive position in achieving optimal business performance (Mehta, Kurbetti & Dhankar, 2014).

Campbell and Park (2017) explored a resource-based strategy, self-interest, corporate social responsibility factors to improve the performance of small businesses in retailing and service-based industries. They found that small business performance was positively related to entrepreneurial orientation and intellectual and social capital resources. Their research supported both the RBV and the instrumental stakeholder approach criticalness in explaining the performance of small businesses. Alexy, West, Klapper, and Reitzig (2018) pointed out that competitive advantage could be obtained when firms managed valuable and scarce resources well under the RBV approach. However, many firms, such as Nokia and IBM, applied open strategies and freed some of the firms useful resources. As a result, the performance was significantly improved as their cost base reduced due to the open resources.

Bromiley and Rau (2016) had revealed that using the RBV against operations management researchers' activities and objectives due to its limitations. Firstly, scholars tend to focus on sustained competitive advantage as the RBV dependent variable and overlooking performance differences across organizations. Secondly, because the resources must be valuable, small quantity, and unique, they cause a problem in measuring firm-related performance. However, Hitt, Carnes, and Xu (2016) argued that their criticisms of RBV were resolved with the extension of recent theoretical work. They offered a better explanation of RBV application in the research of operation management. Performance management, operations strategy, supply chain management, and service/product innovation are the four operation management areas newly introduced to support operations management research under RBV. Ketchen, Wowak, and Craighead (2014) maintained that firms could effectively manage resources in the new product development process with the support of the RBV extension resource orchestration theory.

2.9 Organizational Capabilities and R&D Project Innovation Performance

Organizational capabilities are argued to contribute to organizational performance and survival in the challenging business environment today (Kunc & Bhandari, 2011). Singh et al. (2013) stressed the need to understand and strengthen the organization's capabilities for long-lasting business sustainability. Olsson et al. (2010) stated that organizational innovation capability needs to be enhanced for better organization productivity and performance to fulfill customer and market requirements. Therefore, an organization's innovation capability improvement is recognized as part of the organization's business strategies for better achievements and result generation (Hilman & Kaliappen, 2015). Organizations must use their resource capabilities efficiently and effectively to gain better innovation results for organizational performance and product value improvement (Bontis, Bart, Sáenz, Aramburu & Rivera,2009). The productivity of the firm's resources must be managed properly to yield more process, product, management, and marketing innovations (Forsman, 2009; Nandakumar, Ghobadian, & O'Regan, 2010). Organizational innovation activities should generate more competitive advantage (Hilman & Kaliappen, 2015).

2.9.1 Technological Capabilities and R&D Project Innovation Performance

Kim, Sawng, and Lim (2018) highlighted that adequate competent R&D staff area critical factor for open innovation that improves organizational performance. They are particularly crucial in patent generation and acquisition during the NPD process. Appropriate governmental and political support could ensure the R&D human resources supply to support industry requirements. Small enterprises must establish the right resource management strategy to acquire and possess sufficient R&D resources to sustain their competitive advantage to safeguard their market share. Small

enterprises that do not have enough R&D resources compared to large enterprises are advised to leverage their resources externally rather than building up the internal team...

Liu and Jiang (2016) revealed that firm capabilities had a significant positive effect on NPD and product performance of manufacturing firms in China. Among the organizational capabilities, technological innovation capabilities (TICs) were found to sustain competitive manufacturing advantages significantly. TICs was needed for innovative product and process development that improved Chinese manufacturing productivity and competitiveness. Besides, the criticalness of R&D strategies should be stressed in the management team as they set the right direction to enhance competitive advantage and acquire new business opportunities. As R&D is a highly technical intensive activity, the resources along with the necessary knowledge must be managed effectively to generate the best results, including resolving innovative problems and deciding related technical direction (Piorkowski, Gao, Evans, & Martin, 2012; Singh, Shankar, & Shamah., 2012).

Ren, Eisingerich, and Tsai (2015) found that internationalization had a positive effect on the performance of innovation when marketing capabilities were high. In a similar vein, Vicents, Antunes, and Malva (2016) showed that technological and marketing capabilities had a positive relationship with the intensity of organizational innovation and subsequently, firms' export performance. Firm innovation mediated marketing and technological capabilities for the degree of export output. However, marketing capabilities had a more significant effect on firm export and innovation performance if compared to technological capabilities.

Zawislak et al. (2018), however, demonstrated that technological intensity had no relationship with innovation capabilities. An organization with technical focus could gain better innovation capabilities; however, firms with a low technological level do not necessarily lack innovation capabilities because of the organizational culture and employee mindset. Stanko, Molina-Castillo, and Harmancioglu (2015) found that technological resources had a negative relationship with both technological and market innovativeness performance. However, marketing resources were known to have a positive effect on technological innovativeness. They suggested having long-term customer relationship management to promote technological innovativeness.

2.9.2 Marketing Capabilities and R&D Project Innovation Performance

Marketing capabilities are essential to determine product pricing, channel establishment, publication, and advertisement and are crucial in NPD. However, limited studies investigated the effect of marketing orientation and capabilities on sustainable innovation of firms. Kamboj and Rahman (2017) revealed that marketing orientation had a positive relationship with marketing capabilities, which, in turn, were significantly related to sustainable organizational innovation. Similarly, Udriyah, Tham, and Azam (2019) demonstrated that market orientation and innovation had a positive effect on improving organizational competitive advantage, which had a direct positive relationship with business performance. Other researchers (Ren et al., 2015; Ali & Matsuno, 2018; Vicents et al., 2016) found that marketing capabilities had a significant positive effect on internationalization, innovation performance, business performance, and export performance. Ren et al. (2015) showed that marketing capabilities had a positive relationship with R&D innovation capabilities and a mediation effect on the link between internationalization and innovation performance.

A firm can consider improving the internalization results in boosting its marketing capabilities.

2.9.3 Customer Relationship Management and R&D Project Innovation Performance

Sanchez-Gutierrez, Cabanelas, Lampon, and Gonzalez-Alvarado (2019) revealed that customer relationship management capabilities had a positive effect on cost optimization that improved the creation of customer value, financial performance, and high technology implementation, which improved the competitive advantage of organizations. Customer relationship management capabilities are required to obtain customer feedback regularly that could benefit all levels of an organization in a competitive and challenging business environment.

Berraies and Hamouda (2018) showed that customer empowerment was a crucial factor in enhancing the performance of bank innovation. Other studies also found a positive effect of customer empowerment on innovative product development and success (Fuchs & Schreier, 2011; Jang & Chung, 2015). When customers are empowered to participate in the NPD process, they are likely to offer new and different ideas about the product (Franke, Schreier & Kaiser, 2010). Products designed with customer knowledge and skills tend to be successful because they are developed with clear differentiation that could sell well in the marketplace (Cooper, 1999; Henard & Szymanski, 2001; O'Hern & Rindfleisch, 2008). As a result, there is likely to be almost zero resistance from the customers to accept the new product. It was found that customer orientation supported both exploitative and exploratory innovation, especially the latter (Perks, Gruber, & Edvardsson, 2012).

Ryzhkova (2015) demonstrated that online customer interaction methods had a positive impact on organizational innovation results. Such a method enables organizations to easily collaborate with customers to introduce innovative services or products (Carbonell et al., 2009; Wadell, Sandström, Björk, & Magnusson, 2013). Many scholars maintain that customers could play an important role in boosting firm innovation performance (Edvardsson, Gustafsson, Kristensson, & Witell, 2010; Thomke & von Hippel, 2002).

Valmohammadi (2017) revealed that customer relationship practices had a positive effect on manufacturing organizational innovation capabilities and performance in Iran. Zhang and Yang (2016) also found that innovation enhancement generated from customer relationship management yielded better firm performance. Liu et al. (2017) found that innovation capabilities mediated the relationship between proactive entrepreneurial behavior and new product development performance. They also showed that innovation capabilities had a positive impact on the NPD performance of SMEs. However, the positive impact of SME proactive entrepreneurial behaviour on innovation capabilities was weaker when customer orientation was stronger.

2.9.4 Management Capabilities and R&D Project Innovation Performance

Enterprise management and leadership teams are critical resources for enhancing an organization's innovation capabilities, productivity, and competitive advantage, which are essential for the organization's long-run sustainability (Choi, Kim, Ullah & Kang, 2016; Le & Lei, 2017). Management capabilities are vital resources to drive and enhance the organization's innovation capabilities and effectiveness (Jung, Wu, & Chow, 2008; Jia, Chen, Mei, & Wu, 2018). The innovation capability improvement could be strengthened when the management team exercises transformational

leadership (Le, Lei, Phouvong, Than, Nguyen, & Gong, 2018; Prasad & Junni, 2016; Zheng, Liu, & Gong (2016); Sattayaraksa & Boon-It, 2018) because such a leadership style allows employees to embrace innovation (Vera & Crossan, 2004; Choi et al., 2016). While Sattayaraksa and Boon-itt (2018) found that CEOs officer with transformational leadership had a positive impact on innovation culture but not the innovation performance of product.

Dobni, Klassen, and Nelson (2015) raised their concern about the weak innovation performance of organizations in the United States of America, which they believed is mainly because of the lack of corporate leadership support in knowledge and resource management and innovation strategy. The management team should focus on improving dynamic organizational capabilities critical for the organization to compete and sustain its business in a fast-changing environment. Organizational dynamic capabilities were found to positively affect the performance of organizational innovation and R&D (Babelyte-Labanauske & Nedzinskas, 2017).

Krig and Sandra (2017) found that senior management participation in creating an IP strategy had a positive relationship with IP performance. Companies with integrated IP strategy also indicated a higher level of collaboration across functional units as well as more collaboration concerning IP than companies without an integrated IP strategy. Zhao et al. (2017) stressed that patent management should start early to reduce the risk of technological innovation and improve innovation performance. Rasiah and Chandran (2017) showed that the acquisition and protection of patents had a positive relationship with the commercialization of the patent as well as the innovation performance of organizations. Patent commercialization allows organizations to regain their investments and increase incomes (Rasiah & Chandran, 2017). Therefore, a firm

has to establish an IP strategy and execute it correctly for patent commercialization gain and benefit maximization.

Nagaretham et al. (2012) argued that IP and technology commercialization progress in Malaysia is not up to the expectation, especially in patent applications. Many still rely on large organizations, foreign, and public R&D activities for patent application and commercialization. In the 9th Malaysia Plan (2006-2010) and the 10th Malaysia Plan (2011-2015), the government had spent RM795 million to approve 1,675 R&D projects. Unfortunately, only 487 projects were completed, and 54 projects were successfully commercialized, yielding an 8.3% commercialization rate only (Bong, 2015). Many universities in Malaysia are flooded with research products, but very few ends with commercialization. One of the ways to improve the low patent commercial rate is to have industry collaboration with the local universities (Zaini, Ismail, & Sidek (2017). E&E manufacturing management team can derive the right strategy to ensure the success of product patent commercialization together with universities.

2.10 Conclusion

A literature study was conducted to have a better understanding of the state of research associated with firm capabilities and R&D project innovation performance. Past literature on the underlying theories, such as RBV, was highlighted. This chapter began by reviewing the E&E status and contributions in Malaysia and Penang, followed by a discussion on R&D project innovation performance and technological, marketing, customer relationship management, and management capabilities.

CHAPTER 3

RESEARCH FRAMEWORK

3.0 Introduction

This chapter outlines the methodology used to examine the effect of technological, marketing, customer relationship management, and management capabilities on R&D project innovation performance. It starts with Section 3.1, which describes the research framework and methodology applied. Section 3.2 illustrates the development of hypotheses, while Section 3.3 lists the operational definition of key variables, followed by Section 3.5 that explains the and instrumentation of the variables. Section 3.6 elaborates on the population and sampling. Then Section 3.7 explains the data collection procedure, and Section 3.8 defines the data analysis techniques. Section 3.9 reports the result of the pilot test. Section 3.10 concludes this chapter.

3.1 Research framework

The resource-based theory (RBV) underpinned the present study. According to Barney (1991), the availability of a talented workforce as intangible strategic resources and their capabilities are essential to organizational success. The organization leverages its vital resources effectively to sustain and achieve a competitive advantage, which could improve its performance.

The current study aimed to examine the effect of organizational capabilities, such as management, technological, marketing, and customer relationship management on R&D project innovation performance. Figure 3.1 illustrates the research framework that involves four constructs postulated to determine organizational performance.

They are technological capabilities, marketing capabilities, customer relationship management capabilities, and management capabilities. The framework is an extension of Akroush's (2012)'s framework with the inclusion of management capabilities.

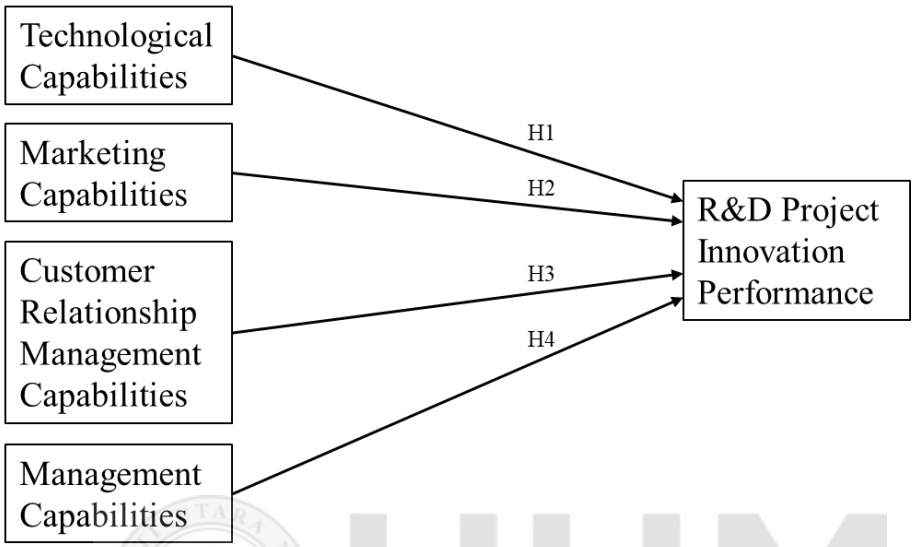

Figure 3.1
Proposed Research Framework

3.2 Hypothesis Development

Four hypotheses were formulated based on the research framework shown in Figure 3.1 as follows:

H1: Technological capabilities have a significant positive effect on R&D project innovation performance.

H2: Marketing capabilities have a significant positive effect on R&D project innovation performance.

H3: Customer capabilities have a significant positive effect on R&D project innovation performance.

H4: Management capabilities have a significant positive effect on R&D project innovation performance.

3.3 Research Designs

According to Creswell (2009), one of the research paradigms used to understand the social world is positivism. Positivism was identified as the utmost suitable paradigm because the present study involved an exploratory analysis in testing the link between the dependent and independent variables that were hypothesized based on RBV. Align with the positivist paradigm, the existing study employed a quantitative approach to generalize the finding to a larger population (Vanderstoep & Johnston, 2009).

There are two common quantitative research designs: survey or experimental research. The current study chose the former to attain the research objectives. According to Kumar (2019), the survey method is an organized method to collect data on the study's variables from a representative sample, where the finding could then be generalized to a larger population. The present study was cross-sectional, which means that the research data were collected once during the research project (Hair, Money, Samouel, & Page, 2007). Most studies that examined manufacturing firm performance used this type of study to analyze the relationship between the variables (Jabar, Soosay, & Santa, 2011; Yusuff, 2004).

Bryman and Bell (2011) advised the use of validated instruments to measure the variables because such instruments tend to be reliable and valid. To further confirm the reliability and validity of the instruments, the present study pilot tested them first before administering them in the final process of data collection. The pilot study was useful to detect any problems that could occur and address them well before the actual study was executed. This approach was employed, as suggested by Bryman and Bell (2011). The pilot test involved the participation of 30 industrial representatives from Penang E&E manufacturing firms. At this stage, unforeseen deficiencies in the

instrument were addressed to maximize the quality of data gathered. The length and the number of questions for each variable were meticulously tailored to enhance the understanding of the research participants.

3.4 Operational Definition

According to Matear et al. (2004), technological capabilities consist of R&D and production capabilities, technological complementarities, and design capabilities. They also refer to the integrity process of using organizational collective resources and knowledge designed for the production process. This study operationalized technological capabilities as one of the critical independent variables that could affect the performance R&D project output significantly. Seven items were used to measure organizational and technological capabilities. The items were taken from Stanko et al. (2015) and Ahmadi and O'Cass (2018). The response format was based on a seven-point Likert scale ranging from (1) "Strongly disagree" to (7) 'Strongly agree.' Table 3.1 illustrates the technological capabilities of items.

Table 3.1
Technological Capabilities Variables, Measurement Items, and Scales

Coding	Measurement Items	Sources	Scale
Tech1	Our company's technical resources were more than adequate for R&D activities.	Stanko et al. (2015)	Likert Scale 1-7
Tech2	Our company's technical resources were more than	Stanko et al. (2015)	Likert Scale 1-7

	adequate for engineering and design activities.		
Tech3	Our company's technical resources were more than adequate for production and manufacturing activities.	Stanko et al. (2015)	Likert Scale 1-7
Tech4	Our company's technical resources had more than adequate capabilities for new technology development.	Ahmadi & O'Cass (2018)	Likert Scale 1-7
Tech5	Our company's technical resources had more than adequate capabilities for technologies changes and trends prediction.	Ahmadi & O'Cass (2018)	Likert Scale 1-7
Tech6	Our company's technical resources had more than adequate capabilities for new technologies adoption to current processes.	Ahmadi & O'Cass (2018)	Likert Scale 1-7
Tech7	Our company's technical resources had more than adequate capabilities for product quality control.	Ahmadi & O'Cass (2018)	Likert Scale 1-7

According to Verona (1999), marketing capabilities are inclusive of marketing management and mix, market research, and marketing complementarities capabilities.

Mu (2015) revealed that marketing capabilities had a positive effect on NPD performance. Besides, Stanko et al. (2015) found that marketing resources and capabilities had a positive impact on technological and marketing innovations. This study, therefore, operationalized marketing capabilities as the key contributor that could affect R&D innovation output performance. Six items adapted from by Mu (2015) were applied to examine marketing capabilities. A seven-point Likert scale ranging from (1) "Strongly disagree" to (7) 'Strongly agree' was used. Table 3.2 illustrates the marketing capabilities items.

Table 3.2
Marketing Capabilities Variables, Measurement Items, and Scales

Coding	**Measurement Items**	**Sources**	**Scale**
Mkt1	Our company's marketing team was able to scan emerging market, trends and events.	Mu (2015)	Likert Scale 1-7
Mkt2	Our company's marketing team was alert to changing market conditions.	Mu (2015)	Likert Scale 1-7
Mkt3	Our company's marketing team was sensitized to listen to latest problem and opportunities in the market.	Mu (2015)	Likert Scale 1-7
Mkt4	Our company's marketing team could anticipate market trends and events accurately before they are fully apparent.	Mu (2015)	Likert Scale 1-7

Mkt5	Our company's marketing team could triangulate market information from different sources.	Mu (2015)	Likert Scale 1-7
Mkt6	Our company's marketing team could effectively listen to, understand, and rapidly respond to relevant market requirements.	Mu (2015)	Likert Scale 1-7

Customer relationship management capabilities are related to organizational capabilities to track each customer or segment of customers and monitor the progress toward the purchase. Day and Van den Bulte (2002) argued that such capabilities could build strong, long-lasting relationships with present and future customers. According to Mu (2015), a customer-based organizational structure had a positive relationship with the performance of NPD. Feng, Cai, Zhang, and Liu (2016) revealed that the effect of customer involvement on NPD performance differed according to the different technological and marketing innovation configurations. Svendsen et al. (2011) showed that client engagement in NPD increased customer-related profitability. Hence, this study operationalized customer relationship management capabilities as the independent factors that could influence R&D project innovation performance. Two items adapted from Mu (2015) and four items from Svendsen et al. (2011).were applied to measure the capabilities. These six items were investigated on a seven-point Likert scale ranging from (1) “Strongly disagree” to (7) ‘Strongly agree’ is applied to gather the participant input. Table 3.3 illustrates the customer relationship management capabilities items.

Table 3.3
Customer Relationship Management Capabilities Variables, Measurement Items, and Scales

Coding	Measurement Items	Sources	Scale
Cust1	Our company's customer relationship resources were able to provide reliable and timely responses to customers' needs.	Mu (2015)	Likert Scale 1-7
Cust2	Our company invests the resources necessary to closely connect with customers.	Mu (2015)	Likert Scale 1-7
Cust3	The fact that the customer presents ideas/suggestions for new product features is important for our product development	Svendsen et al. (2011)	Likert Scale 1-7
Cust4	The fact that the customer presents ideas about new materials we can use to produce the product is important for our product development	Svendsen et al. (2011)	Likert Scale 1-7
Cust5	The fact that the customer communicates to us the needs of its customers is important for us in developing the product further	Svendsen et al. (2011)	Likert Scale 1-7
Cust6	It would not have been possible for our firm to have an efficient product development without the competence that the customer possesses	Svendsen et al. (2011)	Likert Scale 1-7

Hunt (2000) pointed out that organizational management capabilities are intangible. They refer to organizational capabilities to apply resources profitably through a product marketing plan. Organization management capabilities enable manufacturing firms to manage the process of forming, leading, planning, and controlling resources

within an organization with the overall goal of attaining its objective. Zawislak et al. (2012) asserted that management capability is transactional and operational management ability to coordinate the transformation for a technological result. It is to ensure the flow of information to achieve high efficiency, and thus, strategic aims. It allows the firm to deal with unpredictable circumstances by using a range of skills, practices, and techniques to solve problems and take action by choice and decision when technology fails to be perfectly routinized.

Zhao et al. (2017) revealed that patent protection and patent acquisition management strategies were positively affected by the performance of innovation. Yang and Zhang (2018) also found support that senior management positively moderated the relationship between multiple dimensions of customer orientation and new product development performance. Besides, the IP strategy with top management participation was found to yield better IP performance in companies because the developed IP strategy was aligned with the business strategy. Further, Krig and Sandra (2017) showed that the active application of companies' Intellectual Property Rights (IPR) resulted in the exploitation of IP value. Examples of IPR are licensing deals, collaborations, negotiations, enforcement, or improved competitiveness, which were higher among these companies (Krig & Sandra, 2017). Therefore, this study operationalized management capabilities as the independent factors that could impact R&D project innovation performance. Twelve items were applied to examine management capabilities. Ten of them were adapted from Zhao et al. (2017), and the remaining twos were adapted from Yang and Zhang (2018) and Krig and Sandra (2017), respectively. Seven-point Likert scale ranging from (1) "Strongly disagree" to (7) 'Strongly agree' is applied to gather the participant input. Table 3.4 illustrates the items.

Table 3.4
Management Capabilities Variables, Measurement Items, and Scales

Coding	Measurement Items	Sources	Scale
Mgm1	Our company main goal of obtaining patents is to reduce market uncertainty.	Zhao, Xiang & Yi (2017)	Likert Scale 1-7
Mgm2	Our company main goal of obtaining patents to reduce technology fuzziness [being indistinct and without sharp outlines].	Zhao, Xiang & Yi (2017)	Likert Scale 1-7
Mgm3	Our company has sufficient capital investment in R&D and patent acquisition.	Zhao, Xiang & Yi (2017)	Likert Scale 1-7
Mgm4	Our company obtains patents not only internally but also externally.	Zhao, Xiang & Yi (2017)	Likert Scale 1-7
Mgm5	Our company considers patents as an important strategic resource.	Zhao, Xiang & Yi (2017)	Likert Scale 1-7
Mgm6	Our company periodically or regularly assesses its patents risks.	Zhao, Xiang & Yi (2017)	Likert Scale 1-7
Mgm7	Our company regards patent protection as a feasible way to protect its innovative technologies.	Zhao, Xiang & Yi (2017)	Likert Scale 1-7

Mgm8	Our company has a special department or designated staff to deal with patent protection.	Zhao, Xiang & Yi (2017)	Likert Scale 1-7
Mgm9	Our company has owned the patents in the production and provision of its leading products or services.	Zhao, Xiang & Yi (2017)	Likert Scale 1-7
Mgm10	The increase in resources for innovative product development are mostly satisfied by top management.	Zhao, Xiang & Yi (2017)	Likert Scale 1-7
Mgm11	Our company's patents receive market recognition.	Yang & Zhang (2018).	Likert Scale 1-7
Mgm12	Our company R&D, production, marketing, and other functions team collaboration for new product development IP generation are strong.	Krig & Sandra (2017).	Likert Scale 1-7

Mataradzija, Rovcanin & Mataradzija (2013) noted that innovations in the narrow sense include intellectual property (IP), which contains copyright, patent, license, industrial design, and trademark. Innovation relates to the creative ideas generation and the process of taking those ideas to market or use. Innovation performance is the outcome of the innovation process, such as new concepts to improve processes, products, procedures that increase the differentiation and competitiveness of the products. Organizations can also improve their financial performance through patent commercialization (Lin, Wang, & Li, 2017). Bulsara, Gandhi, and Porey (2010) found that patent commercialization increased the actual profit gained from technology

patent efforts. However, selling a patent is not the only way of patent commercialization. Organizations can also transfer the patents or licensing the patents to other companies (Andries & Faems, 2013).

This study operationalized R&D project innovation performance for firm success and sustainability. Five items related to R&D project innovation performance adapted from Stanko (2015) were used on a seven-point Likert scale ranging from (1) "Strongly disagree" to (7) 'Strongly agree.' Table 3.5 illustrates the items.

Table 3.5
R&D Project Innovation Performance Variables, Measurement Items, and Scales

Coding	**Measurement Items**	**Sources**	**Scale**
Inno1	The technology used to develop new product was new for our company.	Stanko et al. (2015).	Likert Scale 1-7
Inno2	New engineering and design approaches were used to develop a new product.	Stanko et al. (2015).	Likert Scale 1-7
Inno3	Compared with competitors, our company has more patents.	Li et al. (2017)	Likert Scale 1-7
Inno4	Our company's patents are the main contributors to profit growth.	Li et al. (2017)	Likert Scale 1-7

Inno5	Compared with competitors, our company has a higher innovation success rate.	Li et al. (2017)	Likert Scale 1-7

3.5 Measurement of Variables/Instrumentations

Based on Sekaran and Bougie (2003), a questionnaire is a data collection method mostly used because it facilitates data collection and coding of responses. A questionnaire design depends on the research objective (Kumar, 2019). It can be applied to collect qualitative data if the study is exploratory for a better understanding of a given research problem. It also can be used to collect quantitative data if the study is explanatory. This study collected quantitative data to investigate the effects of technological, management, customer, and marketing capabilities on R&D project innovation performance by using a survey questionnaire.

All items identified to measure the variables were assembled in designing the questionnaire. A seven-point Likert scale was adopted to get a precise measure of a participant's evaluation and was more appropriate for a web-based survey and other electronically circulated questionnaires (Finstad, 2010). Although established instruments were used, technical jargon was avoided as much as possible to ensure the clarity of the questions to enable participants to understand the questions asked easily and answer them accurately. Some alternations were also made to the selected items to fit the context of the research.

A predesigned questionnaire survey form was applied in the current research. The survey was segmented into seven portions. The first section asked demographic

questions, such as the participant's job title, name, gender, total years of work experience in the current company, and total years of work experience in the E&E industry. The second section contained organization details, such as the name of the company, how long the company has been established (years), type of the business, yearly revenue, and the total number of employees. The third section measured technological capabilities (seven questions) as illustrated in Table 3.1, the fourth section measured marketing capabilities (six questions) as described in Table 3.2, the fifth section measured customer management relationship capabilities (six questions) as shown in Table 3.3, the sixth section measured management capabilities (12 questions) as explained in Table 3.4, and, finally, the seventh section measured R&D project innovation performance (five questions) as listed in Table 3.5.

3.6 Population and Sampling

According to Kumar (2019), sampling is the procedure of choosing an acceptable number of elements that are representative of the population. The application of the sampling technique depends on the research objectives and resources. The research study's unit of analysis is at the organizational level. The target organizations for this study were the 189 Penang E&E manufacturing firms listed in Invest Penang E&E Directory (Invest Penang, 2019). Invest Penang is the state government portal which aims to attract investment to Penang industries and service sectors. The portal has a direct connection with the majority of the manufacturing firms in Penang. Similar to past studies in this field, 95% level of confidence was used in this research study (Deborah, 2016). Therefore, a total of 127 manufacturing firms were sampled from the 189 population pool based on 95% confidence level Krejcie and Morgan (1970) sample size table.

3.7 Data Collection Procedures

Data were gathered through web-based survey, which was set for six months from February to July 2019. According to Bonometti and Tang (2006), many benefits are associated with web-based surveys through electronic mails. Participants can access the survey questions by clicking the survey link embedded in the electronic mail. Such a technique was found to increase survey responses because it facilitated participants to answer the questions (Baruch & Holtom, 2008). Such a method also enhances distribution. The web-based survey can be easily forwarded to the right participant through the electronic mail. It is a fast, efficient, and involves low costs of distribution. A survey instrument with the interactive form-oriented web pages was created by using SoGoSurvey free service to collect the data because such application is user-friendly. The web survey instrument design also has an introduction letter (refer to Appendix).

The identified manufacturing firms were contacted to obtain relevant information on the targeted participant in the R&D department, such as the contact phone number and email address. At the pre-data collection stage, the targeted participants of the selected organizations were contacted and explained the survey objectives. After the target participants indicated their acceptance to participate in the survey, the web survey link was emailed to them. During the data collection stage, each participant was required to answer the 44 items contained in the questionnaire, in which the instructions were clearly outlined to guide them in completing the survey. The participants were those people likely to have the most organizational knowledge about their company R&D project innovation performance. The participants were contacted continuously for two weeks, either through email or phone call, to increase the response rate.

3.8 Techniques of Data Analysis

SPSS software was applied to analyze categorical and continuous data. A demographic profile of the participants and the descriptive statistics of the variables were generated. Also, factor and reliability analyses were run to assess the instruments used.

3.8.1 Demographic and Organization Factors Analysis

A demographic profile was generated that included the participants' title, name, gender, telephone number, total years of working experience in the current organization, and total years of working experience in the E&E industry. On the other hand, an organizational profile contained information, such as the company name, total years of company establishment, type of business, annual revenue (USD), and the total number of employees.

3.8.2 Factor and Reliability Analysis

Factor analysis is a correlational method used to confirm and group items under a shared variance factor. It reduces the number of items and then arranges them under the same cluster. A factor analysis was conducted on 44 items that measured the independent and dependent variables. A factor loading of 0.5 and above for each item is required for further analysis (Hair, Anderson, Babin, & Black, 2010). A factor loading below the threshold value was removed. After factor analysis, the internal consistency of the constructs was examined through reliability analysis. The total score, which is a summated scale of several items, was combined to represent its consistency in terms of reliability. A Cronbach's alpha value of 0.6 or higher is acceptable in exploratory research (Nunally & Bernstein, 1994). Others recommended that values in

the range of 0.6-0.7 to indicate an adequate level of reliability while a value 0.8 or higher indicates excellent reliability (Hulin, Netemeyer & Cudeck, 2001).

3.8.3 Multicollinearity Diagnostics Analysis

Multicollinearity diagnostics analysis is conducted to check whether the independent variables are highly correlated with each other. Multicollinearity statistics of each construct is determined by the Variance Inflation Factor (VIF). A VIF value of less than ten is desired as there is less multicollinearity effect among the independent variables.

3.8.4 Descriptive Statistics Analysis

Descriptive statistics are carried out to get a better view of the critical characteristics of the data, presented in the form of graphics and quantitative descriptions. The mean, standard deviation, kurtosis, skewness minimum and maximum values were calculated in the study. A value of less than +/- 2.0 skewness and kurtosis and a value of less than ten for standard deviation were considered acceptable for social sciences research.

3.8.5 Correlation Analysis

The strength of a linear relationship between the independent and dependent variables could be known with correlation analysis. The outcome of the analysis is presented in the form of correlation coefficients, which vary from -1.0 to +1.0. The higher the value of the coefficient, the greater the relationship strength and vice versa. A positive and negative sign indicates a positive and negative relationship, respectively.

3.8.6 Regression and Hypotheses Testing Analysis

The regression analysis was carried out to examine the hypotheses. Specifically, the analysis was used to determine the total variance explained in the dependent variable, i.e., innovation performance, by the combined independent variables.

3.9 Pilot Test

Thirty industrial representatives from Penang E&E manufacturing firms were involved in the pilot test. The web-based questionnaires were distributed to them with their agreement. The pilot test was run to assess the validity and reliability of the measures used. It was also executed to assess the clarity of the wordings and sentences used. The feedback was later used to refine the questionnaire to be applied in the final survey.

The reliability test result of the pilot study is shown in Table 3.6. All measures showed an alpha value that exceeded 0.6, suggesting that the instruments were reliable (Hair, Black, Babin, Anderson, & Tatham, 2006).

Table 3.6
Variables Reliability Measurement Results

Variable	**No of items**	**Reliability Analysis Cronbach Alpha**
Technological Capabilities	7	0.928
Marketing Capabilities	6	0.950
Customer Relationship Management Capabilities	6	0.882
Management Capabilities	12	0.969
R&D Project Innovation Performance	5	0.926

3.10 Conclusion

This chapter elaborated on the research framework by identifying the independent and dependent variables used in this study. It also covered population and sampling, the sampling technique used, and the data collection procedure. The unit of analysis was organization. A web-based survey method using a predesigned questionnaire as a to collect data was also highlighted. Such s survey method enables vast data collection in a reasonable timeframe. The operationalization of the variables was also outlined. A pilot test and its results were presented to identify potential problems with the content of the questionnaire before the final survey was run. The SPSS software was used for data analysis study. The pilot test result revealed that the measures were reliable. Chapter 4 presents the results of the data analysis.

CHAPTER 4

Results and Discussion

4.0 Introduction

This chapter describes the data analyses and results. The first section, i.e., Section 4.1, illustrates the descriptive result of the key variables, followed by Section 4.2, which presents the result of the factor analysis of the independent and dependent variables. Section 4.3 offers the result of normality and homoscedasticity assessment. Section 4.4 and Section 4.5 illustrate the result of the reliability and correlation analysis. Next, Section 4.6 describes the result of multiple regression analysis. The chapter ends with Section 4.7 and Section 4.8, which discuss the result and concludes the chapter, respectively.

4.1 Descriptive Statistics of the Data

An online survey was conducted over six months from February to July 2019 to collect data on technological capabilities, customer relationship management capabilities, marketing capabilities, management capabilities, and R&D project innovation performance of E&E manufacturing firms in Penang, Malaysia. The Invest Penang E&E Directory was used to identify companies, irrespective of their size, that had R&D functions and facilities (Invest Penang, 2019). The targeted participants were mainly directors, senior management, and R&D project managers in the manufacturing firms. Emails with web-based survey links were disseminated to 127 participants in the manufacturing organizations that were willing to take part in the survey. At the end of data collection, 56 survey forms were returned. The effective response rate of the survey was 44.1% (56/127), in which case exceeded the minimum acceptable response

rate of ten samples per independent variable (Hair, Black, Babin, & Anderson, 2013; Sekaran & Bougie, 2013).

According to Armstrong and Overton (1977), non-response bias analysis was not required as the response rate of this research was more than 30%. There was also no missing data issue with an online survey. All critical fields must be filled before the survey response could be submitted.

All 56 responses were analyzed to generate a demographic profile of the participants. Of 56 participants, 19.6% were female and 80.4% male. Half of them (50%) and slightly more than half (57.1%) had more than five years of experience in the existing company and E&E industry, respectively. Table 4.1 illustrates the profile.

Table 4.1
Respondents' Demographic of Main Survey

Variables	**Frequency**	**Percentage**
Gender		
Male	45	80.4
Female	11	19.6
Total years of experience in your current organization.		
0-5 years	28	50
6-10 years	14	25
11-15 years	4	7.1
16-20 years	3	5.4
21 years and above	7	12.5
Total years of experience in the Electrical and Electronics (E&E) industry.		
0-5 years	24	42.9
6-10 years	7	12.5
11-15 years	4	7.1
16-20 years	12	21.4
21 years and above	9	16.1

Table 4.2 shows the company profile. More than half of the companies sampled (57.1%) had been established for more than 21 years, 58.9% were large scale companies with more than 1000 employees, 28.6% had more than USD2,000 million annual revenue, and 28.6% had less than USD100 million revenue per year.

Table 4.2
Respondents' Organization Profile of Main Survey

Organization Profile	**Frequency**	**Percentage**
Total years of the company establishment		
0-5 years	5	8.9
6-10 years	7	12.5
11-15 years	10	17.9
16-20 years	2	3.6
21 years and above	32	57.1
The total number of organization employee.		
Small Scale (0-50)	7	12.5
Medium Scale (51-500)	12	21.4
Large Scale (501-1000)	4	7.1
Very Large Scale (More than 1000)	33	58.9
The company annual revenue (USD)		
Less than or equal to 100 Million	16	28.6
More than 100 but less than or equal to 500 Million	7	12.5
More than 500 but less than or equal to 1000 Million	8	14.3
More than 1000 but less than or equal to 1500 Million	4	7.1
More than 1500 but less than or equal to 2000 Million	4	7.1
More than 2000 Million	16	28.6

Descriptive statistics, including standard deviation and mean, were generated to summarize the characteristics of the data. Table 4.3 shows a small difference in the mean values for all the variables. The values of standard deviation indicated a smaller

spread in the data from the mean, implying that a high proportion of the cases in the dataset was quite close to the mean value.

Table 4.3
Descriptive Statistics of the Variables

Variables	Mean	Standard Deviation
Technological Capabilities	5.1473	1.27098
Marketing Capabilities	5.1726	1.16253
Customer Relationship Management Capabilities	5.7929	0.77033
Management Capabilities	4.9980	1.44055
R&D Project Innovation Performance	4.6464	1.22815

4.2 Factor Analysis and Reliability Tests

Exploratory factor analysis (EFA) was executed to predict the number of underlying factors that might be available in the dataset. Reliability was conducted to verify the used instrument's stability and consistency.

4.2.1 Factor Analysis

The factor analysis was run to ascertain the accurate representation of the factors in each construct. According to Hair et al. (2010), individual factor loading values for all items should be more than 0.5 to consider for further analysis. According to Coakes and Stead (2003), as a general rule of thumb, five cases per variable is the minimum for running factor analysis. In keeping with the general rule of thumb, the data collected were fit to conduct the factor analysis.

4.2.1.1 Independent Variables Factor Analysis

The relationship strength among the variables is measured by both Kaiser-Meyer-Olkin (KMO) and Bartlett's test. KMO is used to assess the suitability of using factor analysis and also the sampling appropriateness. The KMO values range from 0 to 1, and the value should be more than 0.5 to run factor analysis (Field, 2000). Table 4.4 shows that the KMO value was 0.837 (KMO > 0.5), which was above the threshold value.

Maurice Barlett introduced Bartlett's test in 1937. The test is used to verify the equality of variance in different populations. It helps to confirm whether the correlation matrix is an identity matrix or not. It shows whether variables are highly correlated, and this provides a rational reason for exploratory factor analysis. The value of Bartlett's sphericity ranges from 0, which is off-diagonal, to 1, which means diagonal. According to Tabachnick and Fidell (2001), the test should yield a value of less than 0.05 to be significant. Table 4.4 shows that Bartlett's sphericity value was 0.000, which was significant. The result showed that the correlation matrix was not an identity matrix. Thus, the result suggested that common method variance bias was not an issue in this study.

Table 4.4
Independent Variables KMO and Bartlett's Test Table

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.837
Bartlett's Test of Sphericity	Approx. Chi-Square	1249.980
	df	276
	Sig.	0.000

Table 4.5 shows the communalities index of the independent variables. Communalities explain the variance in the variables accounted for by the extracted factors. According to Hair, Anderson, Tatham, & Black (2005), the communalities index should be > 0.5. Items that do not meet the criteria should be removed from the factor analysis. The total variance extracted refers to all factors extractable from the analysis. The result also shows the variance percentage attributable to each factor, the existing and previous factor cumulative variance, and the variances of the factors called eigenvalues.

The factor analysis was executed on the correlation matrix as the variables were standardized. It showed that every single variable had a variance of 1 with a total variance of 24, which is the sum of the variables in this study. Table 4.6 shows that 49.474% of the variance was attributed to the first factor, 59.855% from the second factor, and the 67.474% from the third factor, and so on. In component number 6, the cumulative percentage of the initial eigenvalues was 73.043%, and the total eigenvalues were more than 1.0. Based on Hair et al. (2010), this was good and adequate. The result showed that only four factors were significant. The remaining factors, after component number 4, were not significant.

Table 4.5
Independent Variables Communalities Table

Communalities		
	Initial	Extraction
Tech1	1	0.667
Tech2	1	0.671
Tech4	1	0.848
Tech5	1	0.756
Cust2	1	0.611
Cust3	1	0.503
Cust4	1	0.601
Cust5	1	0.529
Cust6	1	0.539

MKT1	1	0.883
MKT2	1	0.865
MKT3	1	0.828
MKT4	1	0.696
MKT5	1	0.908
MKT6	1	0.795
Mgm4	1	0.741
Mgm5	1	0.863
Mgm6	1	0.853
Mgm7	1	0.811
Mgm8	1	0.671
Mgm9	1	0.782
Mgm10	1	0.720
Mgm11	1	0.677
Mgm12	1	0.714

Table 4.6
Independent Variables Total Variance Explained Table

Total Variance Explained						
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.874	49.474	49.474	11.874	49.474	49.474
2	2.492	10.382	59.855	2.492	10.382	59.855
3	1.829	7.619	67.474	1.829	7.619	67.474
4	1.336	5.568	73.043	1.336	5.568	73.043
5	0.972	4.048	77.091			
6	0.839	3.496	80.586			
7	0.746	3.107	83.694			
8	0.616	2.556	86.260			
9	0.484	2.015	88.275			
10	0.417	1.737	90.103			
11	0.401	1.670	91.683			
12	0.311	1.295	92.978			
13	0.299	1.245	94.223			
14	0.262	1.090	95.313			
15	0.226	0.941	96.254			
16	0.189	0.787	97.041			
17	0.184	0.767	97.808			
18	0.164	0.682	98.489			
19	0.100	0.419	98.908			
20	0.081	0.338	99.246			

21	0.072	0.300	99.546
22	0.046	0.190	99.736
23	0.039	0.162	99.897
24	0.025	0.103	100.000

Extraction Method: Principal Component Analysis.

Figure 4.1 demonstrates the scree plot of the independent variables. It is a plot with eigenvalues versus the graph of all factors. It is applied to confirm the number of factors to be kept for further analysis. The graph started to flatten between components 4 and 5. The graph was nearly flat from component 6 and above, which means that the subsequent factors after component 6 accounted for a lesser portion of the total variance. Only four factors were retained as component 5 had an eigenvalue of less than 1.

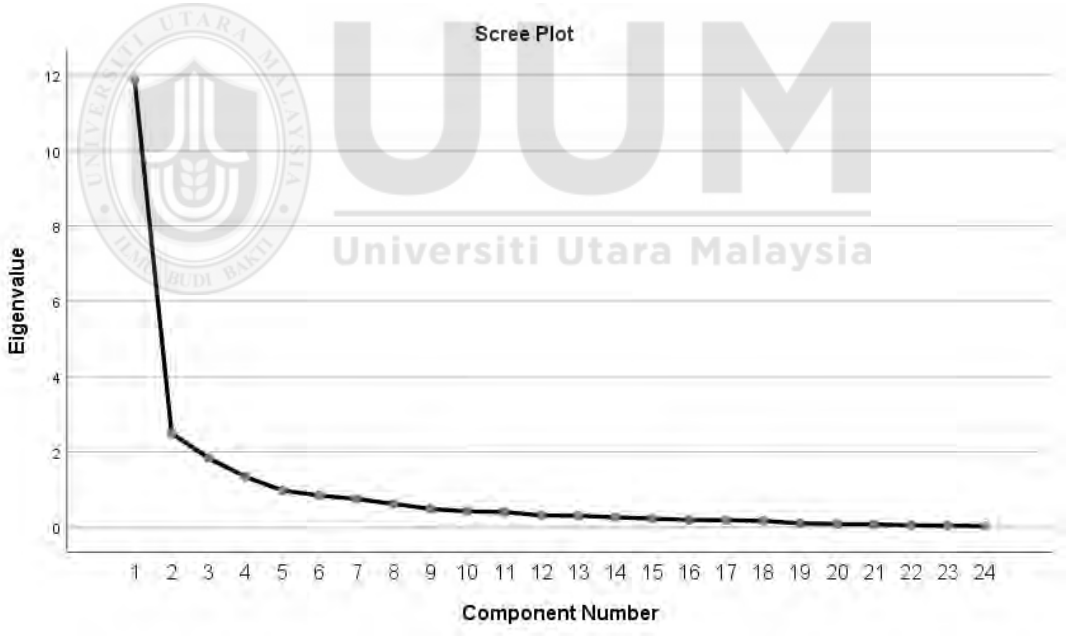

Figure 4.1
Scree Plot Of Independent Variables

Rotation is a method used to simplify the interpretation of factor analysis by decreasing the number of factors with high-loading variables. The loading factors of the variables after the components are rotated are illustrated in the rotated component matrix. Based

on Kumar, Talib, and Ramayah (2013), the loading value must be more than 0.5, and the cross-loading on other factors should be less than 0.5. Hence, Tech3, Tech6, Tech7, Cust1, Mgm1, Mgm2, and Mgm3 were removed from the analysis.

Table 4.7
Independent Variables Rotated Component Matrix Table

Rotated Component Matrix				
Variables	Component			
	1	2	3	4
Tech1			0.706	
Tech2			0.652	
Tech4			0.780	
Tech5			0.708	
Cust2				0.566
Cust3				0.589
Cust4				0.757
Cust5				0.716
Cust6				0.596
Mkt5		0.847		
Mkt6		0.825		
Mkt7		0.868		
Mkt8		0.745		
Mkt9		0.876		
Mkt10		0.810		
Mgm4	0.845			
Mgm5	0.884			
Mgm6	0.800			
Mgm7	0.816			
Mgm8	0.763			
Mgm9	0.803			
Mgm10	0.678			
Mgm11	0.679			
Mgm12	0.752			

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

After that, the common factor theme was checked by looking at the content of the loaded questions. Table 4.7 shows that in factor number 1, highly loaded items were

related to management capabilities. Therefore, factor number 1 was labeled as management capabilities. Factor number 2 had items related to marketing capabilities. Therefore, factor 3 was named as marketing capabilities. Factor number 3 had items loaded on technological capability. Thus, factor 3 was called technological capabilities. Factor number 4 had items associated with fulfilling customer requirements. Hence, factor 4 was labeled as customer relationship management capabilities.

4.2.1.2 Dependent Variables Factor Analysis

According to Table 4.8, the KMO measure was 0.761, and it passed the criteria for further exploratory factor analysis. Bartlett's test was significant, and the correlation matrix was not an identity matrix as the outcome was 0.000.

Table 4.8
Dependent Variable KMO and Bartlett's Test Table

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.675
Bartlett's Test of Sphericity	Approx. Chi-Square	163.034
	df	10
	Sig.	0

Table 4.9 shows how much of the variance in the variables were accounted for by the extracted factors. According to Hair et al. (2005), communalities index should be > 0.5. Thus, all items met the criteria and not removed from the analysis.

Table 4.9

Dependent Variable Communalities Table

Communalities

	Initial	Extraction
Inno1	1	0.678
Inno2	1	0.612
Inno3	1	0.745
Inno4	1	0.685
Inno5	1	0.693

Extraction Method: Principal Component Analysis.

Table 4.10 shows that the initial eigenvalues' cumulative percentage was 68.242%, and the total Eigenvalues was less than 1.0 at component number 2, which means that only one factor was significant. The remaining factors were not significant.

Table 4.10

Dependent Variable Total Variance Explained Table

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.412	68.242	68.242	3.412	68.242	68.242
2	0.576	11.513	79.755			
3	0.546	10.917	90.672			
4	0.345	6.908	97.580			
5	0.121	2.420	100.000			

Extraction Method: Principal Component Analysis.

Figure 4.2 shows the dependent variable scree plot. The graph starts to flatten between components 1 and 2. The graph was nearly flat from component 2 and above. It also means that the subsequent components after component 1 were accounting for a lesser portion of the total variances. There was only one factor was retained as component 2

had an eigenvalue of less than 1. There was no rotating component operation can be performed as there was only one component was extracted.

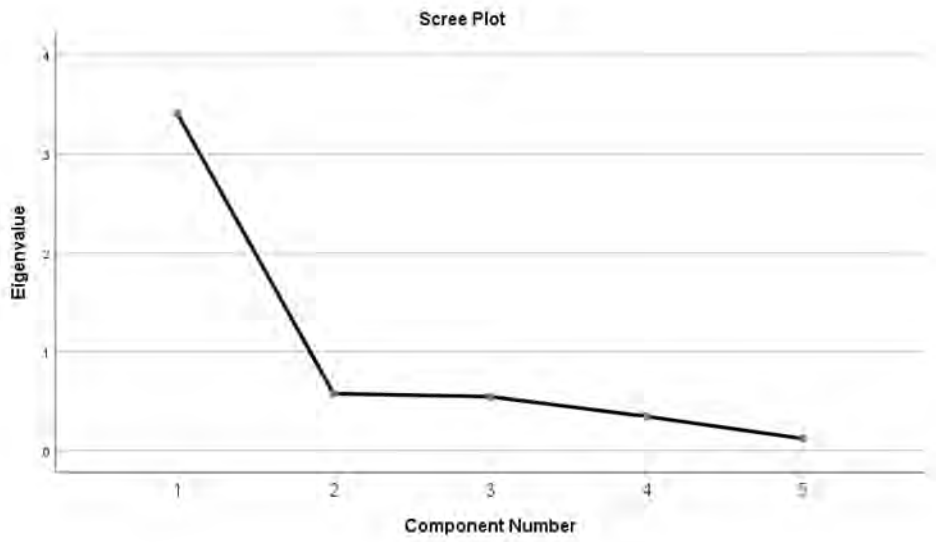

Figure 4.2
Scree Plot Of Dependent Variable

4.3 Normality Test and Homoscedasticity

The Kolmogorov-Smirnov normality test was applied to assess whether all the dependent and independent variables under investigation were normally distributed. As demonstrated in Table 4.11, all variables had normal distribution as the Asymp Sig (2-tailed) values were more than 0.05.

Table 4.11
One sample Kolmogorov Smirnov Normality Test Results

One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		56
Normal Parameters[a,b]	Mean	0
	Std. Deviation	0.72880204
Most Extreme Differences	Absolute	0.077

	Positive	0.077
	Negative	-0.047
Test Statistic		0.077
Asymp. Sig (2-tailed)		.200[c,d]

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

d. This is a lower bound of the true significance.

Figure 4.3 illustrates the scatter plot used to test the homoscedasticity of the data. The homoscedasticity assumption is that the residuals are nearly equal for all predicted dependent variable scores. Homoscedasticity could be verified by checking the same scatter plot in the normality and linearity portions. Data are considered homoscedastic if the residuals plot has the same width for all values of the predicted dependent variable. Heteroscedasticity is generally explained by a cluster of points that is wider as the value for the predicted dependent variable gets higher. The scatter plot in Figure 4.3 was rectangular with points focusing on the center, suggesting that the expectations of homoscedasticity, normality, and linearity were met.

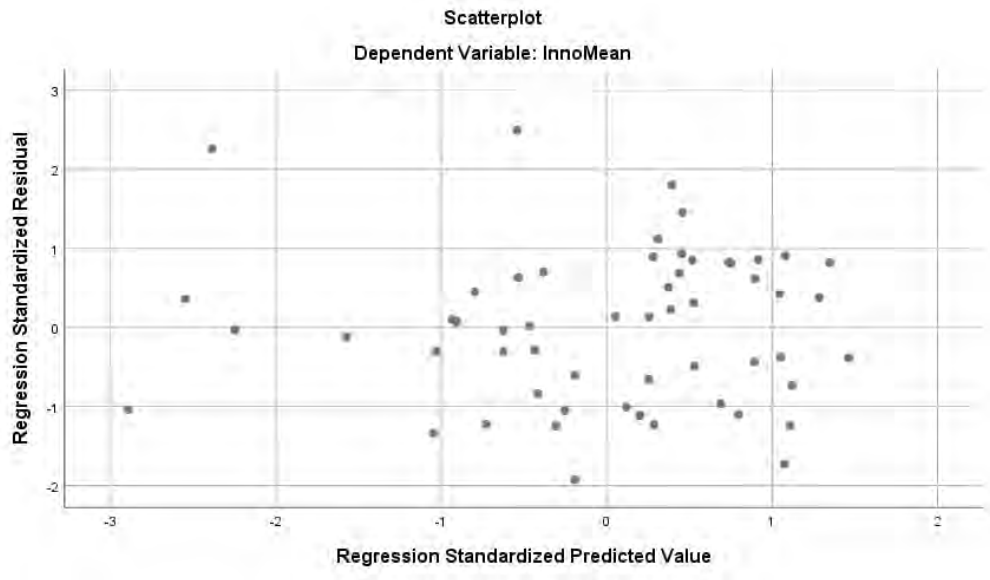

Figure 4.3
Homoscedasticity Scatterplot

4.4 Reliability Analysis

A Cronbach's alpha is applied to check a scale's reliability. A high alpha value means a good correlation between the variables, and a low value means the contrary. Table 4.12 shows that all independent and dependent variables had values more than 0.6, which met the threshold value (Hair et al., 2006).

Table 4.12
Variables Reliability Measurement Results

Variable	**No of items**	**Reliability Analysis Cronbach Alpha**
Technological Capabilities	4	0.870
Marketing Capabilities	6	0.956
Customer Relationship Management Capabilities	5	0.743
Management Capabilities	9	0.953
R&D Project Innovation Performance	5	0.882

4.5 Correlation Analysis

Three critical indices can be gleaned from the correlation analysis. They are Pearson correlation value, sample size, and significance (Sig). The relationship between two continuous variables is described by a Pearson product-moment correlation coefficient. The correlation is applied to measure the degree of the relationship between the variables. However, it could not be used to determine causality. The correlation coefficient ranges from -1 to +1. The closer the value to absolute 1, the stronger the relationship. Hence, a coefficient close to 0 means no relationship between two variables.

Table 4.13
Description of Correlation Values

Correlation Values	Description
0.81 or more	Strong relationship
0.61 – 0.80	Moderately strong relationship
0.41- 0.60	Moderate relationship
0.21 – 0.40	Moderate relationship but weak
Less than 0.20	Weak relationship

Source: McBurney (2001)

The significance value (Sig) is associated with the correlation coefficient. A significant relationship between two variables occurs when the significance value is less than 0.005. The footnote in the correlation table indicates the level of significance and confidence level. A single asterisk means the correlation is significant at a p-value of 0.05 (95%), and a double asterisk means the correlation is significant at a p-value of 0.01 (99%). Table 4.13 shows McBurney's (2001) descriptive of correlation values.

The third information is the sample size, N, which is the number of cases used in the analysis. The sample size in this study was 56. Table 4.14 shows that all independent variables had a significant relationship with the dependent variable. Of the four organizational capabilities, management capabilities (MgmMean) showed the strongest relationship with R&D innovation performance, followed by marketing capabilities (MktMean), technological capabilities (TechMean), and customer relationship management capabilities.

Table 4.14
Variables correlation test results

Correlations						
		TechMean	CustMean	MktMean	MgmMean	InnoMean
TechMean	Pearson Correlation	1	0.463**	0.645**	0.639**	0.506**
	Sig (1-tailed)		0.000	0.000	0.000	0.000
	N	56	56	56	56	56
CustMean	Pearson Correlation	0.463**	1	0.477**	0.439**	0.350**
	Sig (1-tailed)	0.000		0.000	0.000	0.002
	N	56	56	56	56	56
MktMean	Pearson Correlation	0.645**	0.477**	1	0.602**	0.611**
	Sig (1-tailed)	0.000	0.061		0.000	0.000
	N	56	56	56	56	56
MgmMean	Pearson Correlation	0.639**	0.439**	0.602**	1	0.781**
	Sig (1-tailed)	0.000	0.001	0.000		0.000
	N	56	56	56	56	56
InnoMean	Pearson Correlation	0.506**	0.350**	0.611**	0.781**	1
	Sig (1-tailed)	0.000	0.003	0.000	0.000	
	N	56	56	56	56	56

**. Correlation is significant at the 0.01 level (1-tailed).

4.6 Multiple Regression for Dependent Variable

Multiple regression analysis was used to test the research hypotheses in this study.

4.6.1 Model Summary for Dependent Variable Analysis

Table 4.15 illustrates the model summary of the percentage of variance in the dependent variables explained by all independent variables. The coefficient of

determination (R2) and the correlation coefficient (R) indicate the strength of the linear relationship

Table 4.15
Research Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Sig. F Change	Durbin-Watson
1	.805[a]	0.648	0.620	0.000	1.543

a. Predictors: (Constant), MgmMean, CustMean, MktMean, TechMean
b. Dependent Variable: InnoMean

The second column, R, indicated the value of the multiple correlation coefficients between the independent and dependent variables. Based on Guildford (1973)'s rule of thumb, the R-value of 0.805 suggests a strong relationship. The next column is R2 value, which measures the percentage of variance in the dependent variable that is accounted for by the independent variables. In this study, the R2 value was 0.648, which means that, collectively, the independent variables accounted for 64.8% of the dependent variable. The adjusted R2 value is the value of R after taking into account the number of independent variables in the model. It would be best to have the value the same or about the same as R2 value. Table 4.15 shows that the adjusted R and R2 values were pretty close (0.648 – 0.620 = 0.028 or 4.3%), which means that there would be approximately 4.3% less variance in the dependent variable if the model were derived from the population rather than a sample.

The presence of serial correlations among the residuals was tested by using the Durbin-Watson statistics. The value ranges from 0 to 4. There is a strong positive correlation if the value is 4 but a strong negative correlation if the value is 0. The Durbin-Watson statistics should be between 1.5 and 2.5 if the residuals were uncorrelated (Field, 2000).

The Durbin-Watson statistics were 1.543 in this study; hence, there was no serial correlation issue.

4.6.2 ANOVA Analysis

The analysis of variance (ANOVA) checks whether the mean values of two or more groups are significantly different from each other. The improvement in the prediction that results from fitting the model is indicated as an F-ratio. In the ANOVA table, the column for p-values (Sig) needs to be below 0.05 for a significant result. In this survey, all independent variables were significant, as illustrated in Table 4.16.

Table 4.16
ANOVA Analysis

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	53.746	4	13.436	23.457	.000[b]
	Residual	29.213	51	0.573		
	Total	82.959	55			

a. Dependent Variable: InnoMean

b. Predictors: (Constant), MgmMean, CustMean, MktMean, TechMean

4.6.3 Coefficients Table Analysis

The coefficients table offers the slope and the y-intercept values for the regression equation. It can be used to predict when the relationship between the independent and dependent variable is reliable. It is 95% significant if the t-value is more than 1.64. It is 99% significant if the t-value is more than 2.33. This study also checked for the presence of multicollinearity among the independent variables by using tolerance and variance inflation factor (VIF). The VIF value should be less than ten if there is no correlation between the two variables. Based on Table 4.17, the collinearity statistics clearly showed that the tolerance levels exceeded 0.2, and VIF was below the threshold

value of 10. Therefore, the phenomenon of multicollinearity among the predictor constructs did not arise in the study. The independent variables in the research model were not highly correlated.

The null hypotheses are rejected if the p-value is more than 0.05. Based on this criterion, technological capabilities and customer relationship management capabilities did not contribute to R&D project innovation performance at 0.05 level of significance. However, management and marketing capabilities were significantly correlated with R&D project innovation at 0.05 level of significance. On the unstandardized coefficients, β values, for every unit increase in technological capabilities (TechMean), marketing capabilities (MktMean), customer relationship management capabilities (CustMean), and management capabilities (MgmMean) capabilities, the R&D project innovation performance (InnoMean) increased by -0.093, 0.285, -0.067, and 0.594 unit, respectively. On standardized coefficients, β values, for every unit increase in technological capabilities (TechMean), marketing capabilities (MktMean), customer relationship management capabilities (CustMean), and management (MgmMean) capabilities, the R&D project innovation performance (InnoMean) increased by -0.096, 0.273, -0.042, and 0.697, respectively.

Table 4.17
Coefficients Table Analysis

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	1.049	0.782		1.342	0.186		
	TechMean	−0.093	0.117	−0.096	-0.794	0.431	0.472	2.117
	CustMean	−0.067	0.156	−0.042	−0.427	0.671	0.717	1.395
	MktMean	0.285	0.124	0.273	2.324	0.024	0.500	2.002
	MgmMean	0.594	0.098	0.697	6.045	0.000	0.520	1.924

a. Dependent Variable: InnoMean

4.6.4 Multiple Regression Hypothesis Test Results

H1, H2, H3, and H4 were analyzed using hierarchical multiple regression, and the result is presented and discussed below.

Table 4.17 shows that technological capabilities did not have a significant effect on R&D project innovation performance. Thus, H1 was not supported (t = -0.794, Sig = 0.431). However, marketing capabilities had a significant effect on R&D project innovation performance. Therefore, H2 was supported (t = 2.324, Sig = 0.024). Customer relationship management capabilities did not have a significant effect on R&D project innovation performance (t = -0.427, Sig = 0.671). Hence, H3 was rejected. A significant relationship between management capabilities and R&D project innovation performance was observed (t = 6.045, Sig = 0.000). Hence, H4 was supported.

Table 4.18
Hierarchical Multiple Regression Analysis

Hypothesis	Relationship	Standardized Beta	Standard Error	t values	Decision
H1	Technological capabilities --> R&D project Innovation performance	-0.096	0.117	-0.794	Not Supported
H2	Marketing capabilities --> R&D project Innovation performance	0.273	0.124	2.324	Supported
H3	Customer Management relationship capabilities --> R&D project Innovation performance	-0.042	0.156	-0.427	Not Supported

H4	Management capabilities --> R&D project Innovation performance	0.697	0.098	6.045	Supported

4.7 Discussion of Results

Table 4.19 summarizes the result of hypotheses testing.

Table 4.19
Summary of Research Objectives and Hypothesis Testing

Research Objectives and Hypothesis Statements	**Testing Results**
Research Objective 1 (RO1) To examine the effect of manufacturing firms' technological capabilities on R&D project innovation performance. H1: Technological capabilities have a significant effect on R&D project innovation performance.	Not Supported.
Research Objective 2 (RO2) To determine the effect of manufacturing firms' marketing capabilities on R&D project innovation performance. H2: Marketing capabilities have a significant effect on R&D project innovation performance.	Supported
Research Objective 3 (RO3) To identify the effect of manufacturing firms' customer relationship management capabilities on R&D project innovation performance. H3: Customer capabilities have a significant effect on R&D project innovation performance.	Not Supported.
Research Objective 4 (RO4) To evaluate the effect of manufacturing firms' management capabilities on R&D project innovation performance. H4: Management capabilities have significant effect on R&D project innovation performance.	Supported

Past studies found that technological capabilities affected the innovation performance of organizations positively (Aminbeidokhti et al., 2016; Tzokas et al., 2015; Radzi et al., 2017; de Almeida Guerra et al., 2016; Liu et al., 2016). In contrast, this study found no significant relationship. The result of the present study, however, supports Stanco et al. (2015)'s finding that showed no significant effect of technological resource capabilities on technological innovation performance. Besides, Rubera and Kirca (2012) found that low-tech firms had better technological innovation performance than high-tech firms. Since technological innovation involves high risks and costs, the chances to fail the innovation objectives are high even with capable technical resources.

In addition to technological capabilities, customer relationship management capabilities showed no significant relationship with R&D project innovation performance. This finding contradicts past studies that found a positive relationship between firm innovation performance and customer relationship management capabilities (Fernandes & Remelhe, 2016; Ranjan & Read, 2016; Nguyen et al., 2018; Yang & Zhang, 2018; Liu & Atuahene-Gima, 2018). However, Chen and Popovich (2003) argued that many firms failed to yield the intended performance from customer relationship management capabilities because such capabilities need cross-functional, organization-wide, process re-engineering for the right client-focused business orientation, which requires a joined and balanced approach to the process, people and technology. Maxwell and Khan (2018) asserted that internet communicative techniques had redesigned the way of commerce mainly by eliminating the place and time for suppliers and customers with new services and product demands. Electronic customer relationship management is getting importance with the advancement of internet technology. The application of the internet for business purposes has amplified the influence of e-commerce on the entire global business events. Hence, customer

relationship management needs all other functions of team support, such as the information technology department for e-commerce. Zaefarian et al. (2017) found that ending customer relationships helped boost organizational innovation performance because organizations could focus their resources on working on critical innovation projects instead of using the resource to fulfill all customer needs.

Previous research (Ren et al., 2015; Hong et al., 2013; Cacciolatti & Lee., 2016; Mahmoud et al., 2016; Najafi-Tavani et al., 2016; Sulistyo, 2016) demonstrated that marketing capabilities had a positive effect on the innovation performance of product development. The result is in line with the literature. A firm can consider improving the R&D innovation results in boosting its marketing capabilities.

Of all organizational capabilities, management capabilities were found to show the strongest influence on the innovation performance of R&D projects. This finding supports past studies that management teams are a critical resource to enhance an organization's innovation capabilities, productivity, and competitive advantage, which are essential for the long-lasting sustainability of the organization (Choi et al., 2016; Le & Lei, 2017; Jia, Chen, Mei, & Wu, 2018). The management team that exercises transformational leadership could strengthen organizational innovation capability because such leadership allows employees to embrace innovation (Le, Lei, & Than, 2018; Sattayaraksa & Boon-It, 2018). Organizations with an integrated IP strategy and strong senior management support could achieve better IP performance (Krig & Sandra, 2017). Therefore, Penang E&E firms may consider promoting transformation leadership and establish the correct IP strategy to boost the R&D projects' innovation performance.

Chapter 5

Conclusion and Recommendation

5.0 Introduction

This chapter concludes the study. Section 5.1 reiterates the study by highlighting the four research. Section 5.1 and Section 5.2, which illustrate the theoretical and practical implications, follow next. Section 5.3 outlines the study limitations, and Section 5.5, and Section 5.6 offer recommendations for future research. Section 5.7 concludes the study.

5.1 Overview of the Study

The present study investigated the role of organizational capabilities—technological, marketing, customer relationship management, and management—in influencing R&D project innovation performance of manufacturing firms in Penang, Malaysia. The present study was motivated to understand the underperformance of R&D project outputs in Malaysia, as reflected by a declining number of patents year over year. As a consequence of the deterioration, the ability of the E&E industry in Malaysia to gain a competitive advantage for long term sustainability has raised some concerns. Also, the literature has called for empirical investigations to identify the organizational capabilities that could influence R&D project innovation performance. By referring to these gaps, four research questions and consistent hypotheses were developed as follows:

- Research Question 1 (RQ1): Do technological capabilities have a significant effect on R&D project innovation performance?

The present study hypothesized that technological capabilities have a significant effect on R&D project innovation performance. Nevertheless, the finding showed that technological capabilities did not have a significant impact on R&D project innovation performance of Penang E&E manufacturing firms. Therefore, H1 was not supported.

- Research Question 2 (RQ2): Do marketing capabilities have a significant effect on R&D project innovation performance?

This study hypothesized that marketing capabilities have a significant effect on the R&D project innovation performance of Penang E&E manufacturing firms. As expected, the link was supported. Marketing capabilities were found to have a significant positive effect on R&D project innovation performance. Hence, H2 was accepted.

- Research Question 3 (RQ3): Do customer relationship management capabilities have a significant effect on R&D project innovation performance?

This study hypothesized that customer relationship management capabilities have a significant effect on R&D project innovation performance. Nonetheless, no empirical support was found for such a link. Customer relationship management capabilities were not significantly associated with R&D project innovation performance. Therefore, H3 was not accepted.

- Research Question 4 (RQ4): Do management capabilities have a significant effect on R&D project innovation performance?

This study hypothesized that management capabilities have a significant positive effect on R&D project innovation performance. As expected, empirical support was found for such a link. Hence, H4 was accepted.

Table 5.1 lists all the hypothesized relationships between technological, marketing, customer relationship management, management capabilities, and R&D project innovation performance.

Table 5.1
Overview of Reseach Questions and Hypothesized Relationship between Organizational Technological, Marketing, Customer Relationship Management, Management and R&D Project Innovation Performance in E&E Manufacturing firms Penang Malaysia

Research Questions and Hypothesis Statements	**Testing Results**
Research Question 1 (RQ1) Do technological capabilities have a significant effect on R&D project innovation performance? H1: Technological capabilities have a significant effect on R&D project innovation performance.	Not Supported.
Research Question 2 (RQ2) Do marketing capabilities have a significant effect on R&D project innovation performance? H2: Marketing capabilities have a significant effect on R&D project innovation performance.	Supported.
Research Question 3 (RQ3) Do customer relationship management capabilities have a significant effect on R&D project innovation performance? H3: Customer capabilities have a significant effect on R&D project innovation performance.	Not Supported.
Research Question 4 (RQ4) Do marketing management capabilities have a significant effect on R&D project innovation performance? H4: Management capabilities have significant effect on R&D project innovation performance.	Supported

5.2 Theoretical Implications

The present study contributes to the literature by examining the determinants of R&D project innovation performance of E&E manufacturing firms in Penang, Malaysia, by using the resource-based view. A new contribution of the study to the theoretical

understanding of organizational capabilities is the inclusion of management capabilities, which tended to be neglected in the past, and the specific innovation performance of R&D projects that could help organizations achieve a competitive advantage for long-term sustainability. As expected, the finding showed the positive and significant effect of management capabilities on the innovation performance of R&D projects in the E&E industry. More importantly, management capabilities were found to be the strongest determinant of innovation performance, followed by marketing capabilities. Unexpectedly, technological capabilities and customer relationship management capabilities did how a significant impact.

The insignificant role of technological capabilities could be due to the lack of technical resources E&E manufacturing companies in Penang have to develop high-technology products (Rasiah & Chandran, 2017). Manufacturing firms are more inclined to have their home country engineer support and collaborate with local universities to close the technological gap to meet the need for new product development and innovation. On customer relationship management capabilities, there are multiple ways to work closely with customers, such as social media, to understand their requirements and needs (Wang & Kim, 2017). Hence, such an initiative could be outsourced to the social media platform provider, and the resources may not need to reside within the organization.

5.3 Practical Implications

The empirical findings have important practical implications for E&E manufacturing firms. The management team of E&E manufacturing firms is interested in the research results as they have a better insight into the way to achieve better R&D project innovation output in the longer term. The findings of this study showed that

management and marketing capabilities significantly affected R&D project innovation performance, which could enhance the competitive advantage and performance of the E&E manufacturing companies.

In light of the results, the top management of E&E manufacturing firms should take a proactive role in developing internal management and marketing capabilities. They need to realize the criticalness of possessing marketing and management capabilities to improve their R&D project innovation performance that could help enhance business performance. Also, E&E manufacturing firms in Penang, Malaysia, should prioritize the development of management capabilities for better R&D project innovation performance. It is strongly recommended that the management of the manufacturing firms maintain a good talent development program. It includes learning-need identification, coaching, and mentoring for the progressive growth of talented management employees to deliver a competitive edge for business success. It is good to have a management trainee program where talented junior staff is trained and developed to handle more significant roles in the organization when their management skillsets and experience mature. The internally trained managers perform better and faster than external hires as they know the head and tail of the company culture, people, departmental functions, and processes well. The knowledge of internal systems helps them to coordinate and manage their daily tasks and drive for more innovative changes for the benefits of the company. The other potential method to improve the local Penang managers' capability is to participate in cross-country manager exchange programs within the organization. It allows the local management team to learn about good management practice and culture in other nations like the United States, which ultimately support domestics organizations to be well equipped to improve innovation performance.

Furthermore, managers should be encouraged to play leadership and entrepreneurial roles on top of their daily administrative tasks. They must be good at detecting opportunities, creating and establishing practical business structures, developing organizational capabilities, and leading the transformation of the organization. All these capabilities are generally reflected as the dynamic capabilities of the organization, which have been shown to affect organizational innovation performance (Teece, 2016) positively. The managers should implement a good strategy that can foster the innovation culture for competitive success. An E&E manufacturing firm that embarks on an innovation culture to accelerate the product or process innovation needs to put in place the product innovative development process for high performance and differentiation while promoting the long-term organizational growth. Eventually, this strategy will lead to the development of a series of highly competitive products for their market and long-term business success.

Managers must pay more attention to develop marketing capabilities so that they can introduce highly innovative, differentiated, and suitable products to the market. The marketing function should lead to the R&D process. Besides, the management team must treat the marketing concept as a philosophy and promote it across the entire firm. They should encourage global export orientation which has a positive relationship with competitive advantages of distribution and costs (Tsougkou, Cadogan, Hodgkinson, Oliveira, Abdul-Talib, Story & Despoudi , 2018). The management team also needs to promote internal collaboration between different departments and function teams to generate more patents and filing rates along the R&D process for new product development (Jeng & Pak, 2016; Zhou et al., 2012). Teamwork quality has positive influence on NPD speed (Abdul-Talib, Alanazi, Ashari, & Zamani, 2020). The NPD innovation speed does mediate the relationship between market orientation and new

product success (Zamani, Abdul-Talib, & Ashari, 2016). The management team could assist the team members if they encounter any financial or technical roadblocks by engaging the right government bodies, such as MIDA and MyIPO, as well as local universities.

The marketing team must also equip themselves with enough technical knowledge to deal with clients. It helps them to understand their customer requirements for new product development. It will avoid unnecessary problems such as new product redesign due to inaccurate customer requirements that will cause a high loss in company resources and costs. Hence, internal product technical training must be periodically conducted for marketers to ensure their product technical knowledge is up to date. Moreover, the marketing team must have a high sensitivity to market changes and opportunities, such as consumer spending trends and preferences. They can obtain related information through consumer big data analysis. The required raw data could be obtained from social media interaction, as well as market surveys. The data help the organization to know future consumer needs and get the products ready upfront to address the new market requirements.

The marketing team may explore more new sales channels and methods for their products. Retails shops and distributors may not be efficient anymore in the globalization era. A new generation of consumers is already familiar with the online purchase method without any physical interference from salespeople. However, customers may expect to have technical advice from time to time on their purchase. The technical marketing team should be ready online to respond to customer inquiries, but the team does not necessarily have to appear to interact with the customer directly and physically.

Although technological and customer relationship management capabilities were found not to have a significant effect on R&D project innovation performance, collectively, they were found to be significant in influencing innovation performance. On technological capabilities, Penang E&E manufacturing firms may consider having collaborations or outsourcing with external research institutions or universities to improve their innovation performance (Reichert et al., 2016; Zawislak et al., 2015; Najafi-Tavani et al., 2018; Martín-de Castro, 2015). By doing so could boost the low rate of patent commercialization, which ultimately benefits the organization (Rasiah & Chandran, 2017). Indeed the environmental dynamism such as client requests, technology changes and market competition levels have a positive relationship with outsourcing management success (Hassan, Razalli, & Abdul-Talib, 2014). Hence, it is low risk to do so. Also, Penang E&E manufacturing firms may consider incorporating social media channels to interact and understand their customers in more detail. By doing so, companies could enhance their customer relationship management capabilities (Preikschas, Cabanelas, Rüdiger & Lampón, 2017; Wang & Kim, 2017; Lam et al., 2016; Bugshan, 2015; Zaefarian et al., 2017).

Finally, practitioners in the Penang E&E manufacturing sector may apply the findings to benchmark their R&D innovation activities and processes. They can further develop their company innovation strategy to improve the innovation performance of different activities and processes.

5.4 Limitations of the Study

Like other research endeavors, the present study has some limitations, which need to be considered when interpreting the results. Firstly, the generalizability of the findings

in this study is only restricted to manufacturing firms operating in the E&E business sector in Penang, Malaysia. The result may not necessarily be generalizable to other industries or sectors, such as the food industry, because they may have different characteristics and structures. Furthermore, the generalizability is limited because of the small sample size. Secondly, since this study was cross-sectional and exploratory, it provides a preliminary and static view of the phenomenon under investigation. Any changes in innovation performance as a result of changes in the organizational capabilities could not be discerned.

5.5 Recommendations for Future Research

The current study offers some insight into the role of actual organizational capabilities in contributing to the R&D project innovation performance of manufacturing firms. However, more studies could be undertaken in the future to validate further the findings. Firstly, the study suggests that future researchers consider controlling some variables that could confound the result, such as the size of the firm. Besides, future research could further explore the effects of organizational capabilities on R&D project innovation performance of manufacturing firms in the northern region or across Malaysia to address the issue of limited generalizability. Thirdly, the same research framework could be applied to the service industry or other manufacturing sectors, such as food and automotive, for a meaningful comparison. Lastly, future research may want to examine further why technological capabilities and customer relationship management capabilities did not affect the R&D project innovation performance significantly. Such research has theoretical and practical implications.

Besides, future research could further explore the effects of organizational capabilities towards R&D project innovation performance in the northern region or the whole of

Malaysia E&E manufacturing firms. It helps to generalize the study in a broader region. Thirdly, the same research framework could be applied to the service industry or the other manufacturing sectors such as food and automotive. It is interesting to know the research results, whether they are the same as E&E manufacturing industry in Penang. Lastly, it is also essential to know the reasons that Penang E&E manufacturing firms' technological, marketing and customer relationship capabilities do not affect the R&D project innovation performance significantly. It helps to close the existing research gap and limitations.

5.6 Conclusion

In the wake of competitive pressures because of the low R&D project outputs in Malaysia, E&E manufacturing firms face a high risk of not able to compete and sustain their business in the long run. Therefore, superior organizational capabilities are mandatory to manage R&D projects for better innovation performance that delivers an undertaken. Specifically, it examined the effect of organizational capabilities, such as management, technological, marketing, and customer relationship management capabilities, on R&D project innovation performance of manufacturing firms in the E&E industry in Penang.

This study was able to answer four research questions and meet the objectives outlined in the first chapter. However, despite the hypothesized effects based on past studies, only management and marketing capabilities were found to enhance innovation performance significantly. Of the two, the former was found to be the strongest predictor of R&D project innovation performance. However, collectively, the four organizational capabilities were found to significantly enhance innovation performance, suggesting the importance of developing the internal capabilities for

future growth and sustainability of manufacturing firms in the E&E industry in Penang. However, of the four, the manufacturing firms should prioritize in strengthening their management capabilities. Since the research model showed a moderately strong explanatory power, it benefits practitioners in E&E manufacturing firms in Penang and other researchers in the field of strategic management.

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APPENDIX A: RESEARCH QUESTIONNAIRES

UNIVERSITI UTARA MALAYSIA

Dear Participants,
I am Chee Wei Keung, a research student of Universiti Utara Malaysia Doctor of Business Administration (DBA) program. As part of the program, I am surveying, "The effect of organizational capabilities towards R&D project innovation performance in Penang E&E manufacturing firms."

The findings from this study are useful for Penang E&E manufacturing firms. It will provide the quantitative evidence which links the organizational capabilities to R&D projects innovation performance. Appreciate it if you could answer all the questions and statements carefully. The information given by you will influence the accuracy and success of this study.

All your responses will be kept strictly confidential and your identity will remain anonymous. All the data will be aggregated and will be strictly used for academic purposes only.

Please access the online survey questions in the link below:

Sincerely

Chee Wei Keung Matric No. 94227, DBA - Student Universiti Utara Malaysia.

PART 1: DEMOGRAPHIC FACTORS (ABOUT YOURSELF)

Please fill or tick (□) the appropriate box that corresponds to your answer to each of the questions below:

1. Name (Optional): _____

2. Gender
Male □
Female □

3. The number of years of experience in the current organization (Please specify):
_____years.

4. The number of years of experience in E&E industry (Please specify):
_____years.

PART 2: ORGANIZATION DETAILS

1. Name of the organization: _____

2. Total years of establishment: _____

3. Annual Revenue (USD):

0-100 Millions	□
More than 100 but less than or equal to 500 Millions	□
More than 500 but less than or equal to 1000 Millions	□
More than 1000 but less than or equal to 1500 Millions	□
2000 Millions and above	□

4. Organization size: (Regarding number of employees)

Small-scale (1 to 50)	□
Medium scale (51 to 200)	□
Large-scale (201 to 500)	□
Very large scale (More than 500)	□

PART 3: Here are some statements that describe your company's technological capabilities. Please indicate how strongly you agree or disagree with each of them. Circle the one of scale number (1 to 7) that applied.

[Strongly Disagree (1), Disagree (2), Slightly Disagree (3), Neutral (4), Slightly Agree (5), Agree (6), Strongly Agree (7)]

Our company's technical resources were more than adequate for R&D activities.	1	2	3	4	5	6	7
Our company's technical resources were more than adequate for engineering and design activities.	1	2	3	4	5	6	7
Our company's technical resources were more than adequate for production and manufacturing activities.	1	2	3	4	5	6	7
Our company's technical resources had more than adequate capabilities for new technology development.	1	2	3	4	5	6	7
Our company's technical resources had more than adequate capabilities for technologies changes and trends prediction.	1	2	3	4	5	6	7
Our company's technical resources had more than adequate capabilities for new technologies adoption to current processes.	1	2	3	4	5	6	7
Our company's technical resources had more than adequate capabilities for product quality control.	1	2	3	4	5	6	7

PART 4: Here are some statements that describe your company customer management relationship capabilities. Please indicate how strongly you agree or disagree with each of them. Circle the one of scale number (1 to 7) that applied.

……

[Strongly Disagree (1), Disagree (2), Slightly Disagree (3), Neutral (4), Slightly Agree (5), Agree (6), Strongly Agree (7)]

Our company's customer relationship resources were able to provide reliable and timely responses to customers' needs.	1	2	3	4	5	6	7
Our company invests the resources necessary to closely connect with customers.	1	2	3	4	5	6	7
The fact that the customer presents ideas/suggestions for new product features is important for our product development	1	2	3	4	5	6	7
The fact that the customer presents ideas about new materials we can use to produce the product is important for our product development	1	2	3	4	5	6	7
The fact that the customer communicates to us the needs of its customers is important for us in developing the product further	1	2	3	4	5	6	7
It would not have been possible for our firm to have an efficient product development without the competence that the customer possesses	1	2	3	4	5	6	7

PART 5: Here are some statements that describe your company marketing capabilities. Please indicate how strongly you agree or disagree with each of them. Circle the one of scale number (1 to 7) that applied.

[Strongly Disagree (1), Disagree (2), Slightly Disagree (3), Neutral (4), Slightly Agree (5), Agree (6), Strongly Agree (7)]

Our company's marketing team was able to scan emerging market, trends and events.	1	2	3	4	5	6	7
Our company's marketing team was alert to changing market conditions.	1	2	3	4	5	6	7
Our company's marketing team was sensitized to listen to the latest problem and opportunities in the market.	1	2	3	4	5	6	7
Our company's marketing team could anticipate market trends and events accurately before they are fully apparent.	1	2	3	4	5	6	7
Our company's marketing team could triangulate market information from different sources.	1	2	3	4	5	6	7
Our company's marketing team could effectively listen to understand, and rapidly respond to relevant market requirements.	1	2	3	4	5	6	7

PART 6: Here are some statements that describe your company management capabilities. Please indicate how strongly you agree or disagree with each of them. Circle the one of scale number (1 to 7) that applied.

[Strongly Disagree (1), Disagree (2), Slightly Disagree (3), Neutral (4), Slightly Agree (5), Agree (6), Strongly Agree (7)]

Our company main goal in obtaining patents is to reduce market uncertainty.	1	2	3	4	5	6	7
Our company main goal in obtaining patents to reduce technology fuzziness [being indistinct and without sharp outlines].	1	2	3	4	5	6	7
Our company has sufficient capital investment in R&D and patent acquisition.	1	2	3	4	5	6	7
Our company obtains patents not only internally but also externally.	1	2	3	4	5	6	7
Our company considers patents as an important strategic resource.	1	2	3	4	5	6	7
Our company periodically or regularly assesses its patents risks.	1	2	3	4	5	6	7
Our company regards patent protection as a feasible way to protect its innovative technologies.	1	2	3	4	5	6	7
Our company has a special department or designated staff to deal with patent protection.	1	2	3	4	5	6	7
Our company has owned the patents in the production and provision of its leading products or services.	1	2	3	4	5	6	7
Our company's patents receive market recognition.	1	2	3	4	5	6	7
The increase in resources for innovative product development is mostly satisfied with top management.	1	2	3	4	5	6	7
Our company R&D, production, marketing, and other functions team collaboration for new product development IP generation are strong.	1	2	3	4	5	6	7

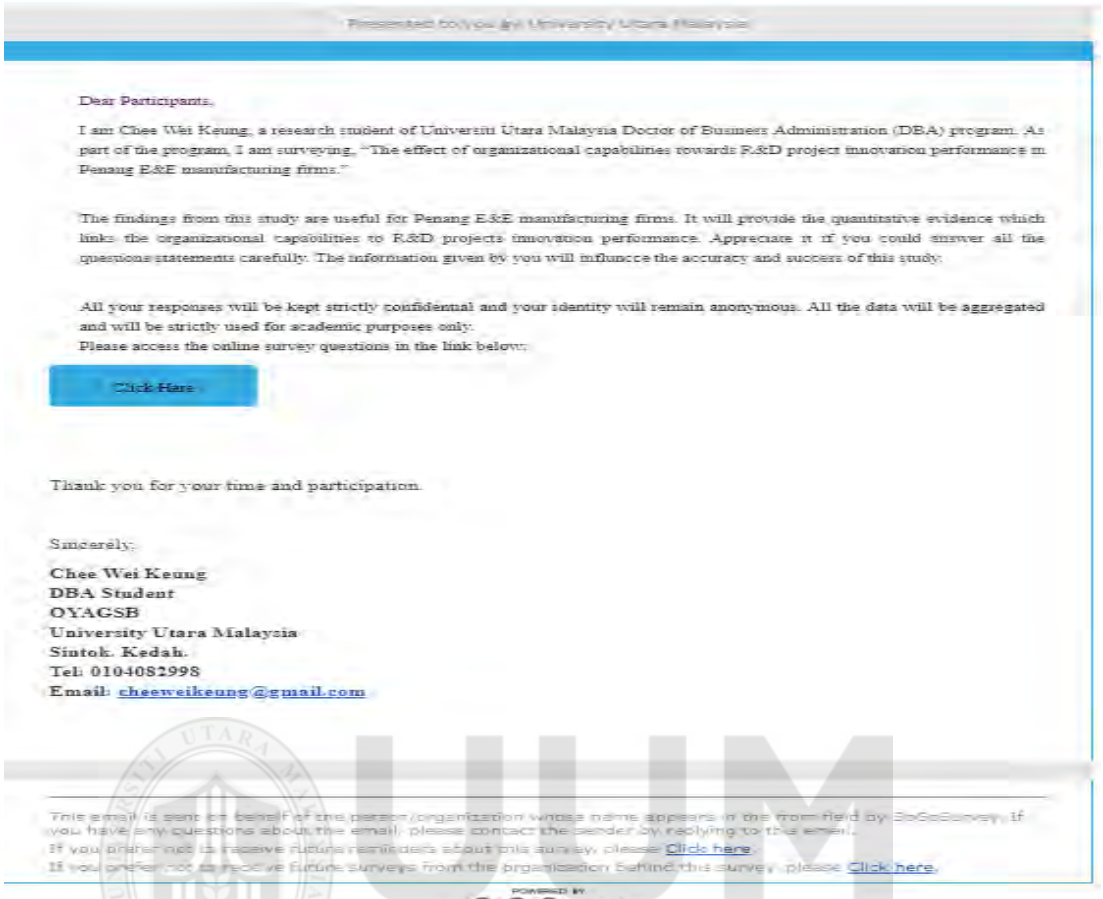
PART 7: Here are some statements that describe your company R&D project innovation performance. Please indicate how strongly you agree or disagree with each of them. Circle the one of scale number (1 to 7) that applied.

……

[Strongly Disagree (1), Disagree (2), Slightly Disagree (3), Neutral (4), Slightly Agree (5), Agree (6), Strongly Agree (7)]

The technology used to develop new product was new for our company.	1	2	3	4	5	6	7
Engineering and design activities were new to our company.	1	2	3	4	5	6	7
Compared with competitors, our company has more patents.	1	2	3	4	5	6	7
Our company's patents are the main contributors to profit growth.	1	2	3	4	5	6	7
Compared with competitors, our company has a higher innovation success rate.	1	2	3	4	5	6	7

APPENDIX B: WEB-BASED RESEARCH QUESTIONNAIRES



Presented to you by Universiti Utara Malaysia

Dear Participants,

I am Chee Wei Keung, a research student of Universiti Utara Malaysia Doctor of Business Administration (DBA) program. As part of the program, I am surveying, "The effect of organizational capabilities towards R&D project innovation performance in Penang E&E manufacturing firms."

The findings from this study are useful for Penang E&E manufacturing firms. It will provide the quantitative evidence which links the organizational capabilities to R&D projects innovation performance. Appreciate it if you could answer all the questions/statements carefully. The information given by you will influence the accuracy and success of this study.

All your responses will be kept strictly confidential and your identity will remain anonymous. All the data will be aggregated and will be strictly used for academic purposes only.
Please access the online survey questions in the link below:

Click Here

Thank you for your time and participation.

Sincerely,

Chee Wei Keung
DBA Student
OYAGSB
Universiti Utara Malaysia
Sintok, Kedah.
Tel: 0104082998
Email: cheeweikeung@gmail.com

This email is sent on behalf of the person/organization whose name appears in the from field by SoGoSurvey. If you have any questions about this email, please contact the sender by replying to this email.
If you prefer not to receive future reminders about this survey, please Click here.
If you prefer not to receive future surveys from the organization behind this survey, please Click here.

POWERED BY SoGoSurvey

PART 1: DEMOGRAPHIC FACTORS (ABOUT YOURSELF)
Please fill or select the appropriate option that corresponds to your answer to each of the questions below:

1. Please fill in your personal information. However, you can skip this section if you choose to be anonymous respondent.

Title (Optional)

Full Name (Optional)

Gender --Select--

Telephone (Optional)

--Select--
Male
Female

* 2. Total years of experience in your current organization.

- 0-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21 years and above

* 3. Total years of experience in the Electrical and Electronics (E&E) industry.

- 0-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21 years and above

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Clear answers on page

Next

14%

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The Effect Of Organizational Capabilities Towards R&D Project Innovation Performance in Penang E&E Manufacturing firms.

* Required Information

PART 2: ORGANIZATION DETAILS
Please fill or select the appropriate option that corresponds to your answer to each of the questions below:

* 4. Company name:

Characters Remaining: 100

* 5. Total years of the company establishment

- 0-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21 years and above

* 6. Type of Business

- Semiconductor
- Test and Measurement Equipment
- LED
- Biology Technology
- Computer
- Telecommunication
- Other (Please specify)

* 7. The company annual revenue (USD).

- Less than or equal to 100 Millions
- More than 100 but less than or equal to 500 Millions
- More than 500 but less than or equal to 1000 Millions
- More than 1000 but less than or equal to 1500 Millions
- More than 1500 but less than or equal to 2000 Millions
- More than 2000 Millions
- Other (Please specify)

* 8. The total number of organization employee.

- Small Scale (0-50)
- Medium Scale (51-500)
- Large Scale (501-1000)
- Very Large Scale (More than 1000)
- Other (Please specify)

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Back | Clear answers on page | Next

25%
Page 2 of 7

The Effect Of Organizational Capabilities Towards R&D Project Innovation Performance in Penang E&E Manufacturing firms.

* Required Information

PART 3: Here are some statements that describe your company technological capabilities. Please indicate how strongly you agree or disagree with each of them.

* 9. Our company's technical resources were more than adequate for R&D activities.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 10. Our company's technical resources were more than adequate for engineering and design activities.

Slightly Disagree	Neither Agree Or Disagree	Slightly Agree	Agree	Strongly Agree
3	4	5	6	7

* 11. Our company's technical resources were more than adequate for production and manufacturing activities.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 12. Our company's technical resources had more than adequate capabilities for new technology development.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 13. Our company's technical resources had more than adequate capabilities for technologies changes and trends prediction.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 14. Our company's technical resources had more than adequate capabilities for new technologies adoption to current processes.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 15. Our company's technical resources had more than adequate capabilities for product quality control.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

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43%

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The Effect Of Organizational Capabilities Towards R&D Project Innovation Performance in Penang E&E Manufacturing firms.

* Required Information

PART 4: Here are some statements that describe your company customer management relationship capabilities. Please indicate how strongly you agree or disagree with each of them.

* 16. Our company's customer relationship resources were able to provide reliable and timely responses to customers' needs.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 17. Our company invests the resources necessary to closely connect with customers.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 18. The fact that the customer presents ideas/suggestions for new product features is important for our product development.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 19. The fact that the customer presents ideas about new materials we can use to produce the product is important for our product development.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 20. The fact that the customer communicates to us the needs of its customers is important for us in developing the product further.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 21. It would not have been possible for our firm to have an efficient product development without the competence that the customer possesses.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

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Back | Clear answers on page | Next

57%

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The Effect Of Organizational Capabilities Towards R&D Project Innovation Performance in Penang E&E Manufacturing firms.

* Required information

PART 5: Here are some statements that describe your company marketing capabilities. Please indicate how strongly you agree or disagree with each of them.

* 22. Our company's marketing team was able to scan emerging market, trends and events.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 23. Our company's marketing team was alert to changing market conditions.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 24. Our company's marketing team was sensitized to listen to the latest problem and opportunities in the market.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 25. Our company's marketing team could anticipate market trends and events accurately before they are fully apparent.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 26. Our company's marketing team could triangulate market information from different sources.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 27. Our company's marketing team could effectively listen to understand, and rapidly respond to relevant market requirements.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

UUM DBA Research Study

The Effect Of Organizational Capabilities Towards R&D Project Innovation Performance in Penang E&E Manufacturing firms.

* Required Information

Here are some statements that describe your company management capabilities. Please indicate how strongly you agree or disagree with each of them.

* 28. Our company main goal in obtaining patents is to reduce market uncertainty.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 29. Our company main goal in obtaining patents to reduce technology fuzziness (being indistinct and without sharp outlines).

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 30. Our company has sufficient capital investment in R&D and patent acquisition.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 31. Our company obtains patents not only internally but also externally.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 32. Our company considers patents as an important strategic resource.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 33. Our company periodically or regularly assesses its patents risks.

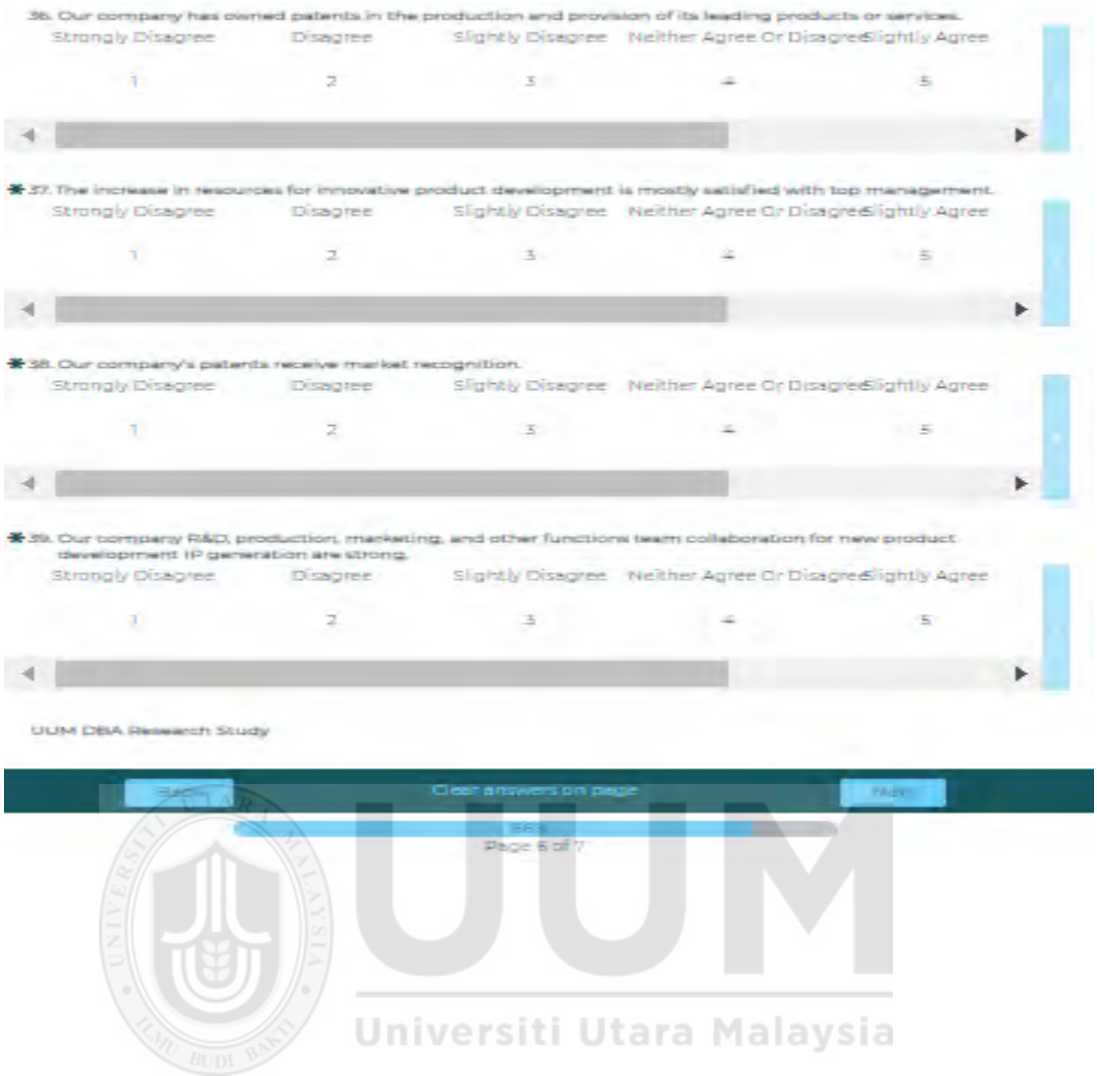
Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 34. Our company regards patent protection as a feasible way to protect its innovative technologies.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 35. Our company has a special department or designated staff to deal with patent protection.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5



The Effect Of Organizational Capabilities Towards R&D Project Innovation Performance in Penang E&E Manufacturing firms.

* Required Information

Here are some statements that describe your company R&D Project Innovation Performance. Please indicate how strongly you agree or disagree with each of them.

* 40. The technology used to develop new product was new for our company.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

41. New engineering and design approaches were used to develop a new product.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

42. Compared with competitors, our company has more patents.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

43. Our company's patents are the main contributors to profit growth.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

44. Compared with competitors, our company has a higher innovation success rate.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

UUM DBA Research Study

Back | Clear answers on page | Submit

100%

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The Effect Of Organizational Capabilities Towards R&D Project Innovation Performance in Penang E&E Manufacturing firms.

* Required Information

Here are some statements that describe your company management capabilities. Please indicate how strongly you agree or disagree with each of them.

* 32. Our company main goal in obtaining patents is to reduce market uncertainty.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 33. Our company main goal in obtaining patents to reduce technology fuzziness [being indistinct and without sharp outlines].

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

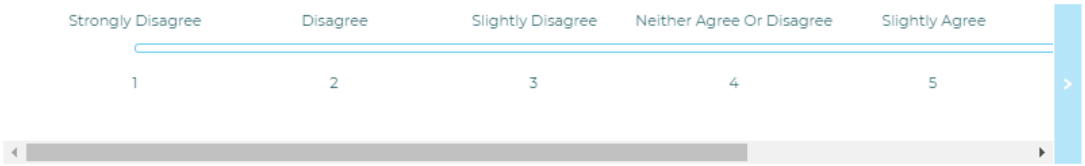
* 34. Our company has sufficient capital investment in R&D and patent acquisition.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

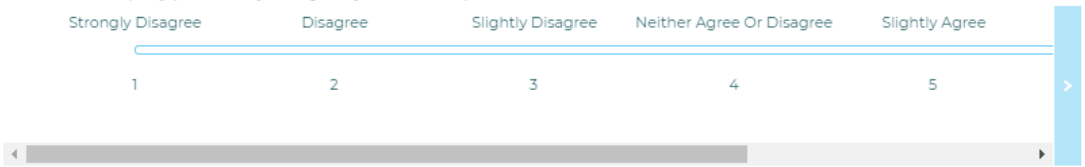
* 35. Our company obtains patents not only internally but also externally.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

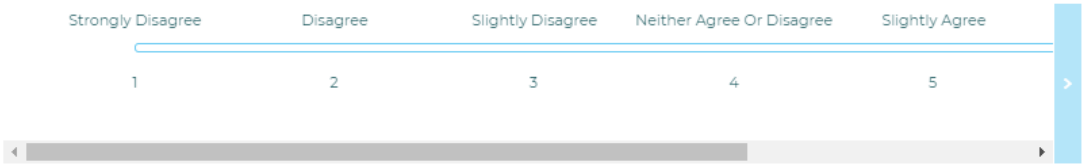
* 36. Our company considers patents as an important strategic resource.



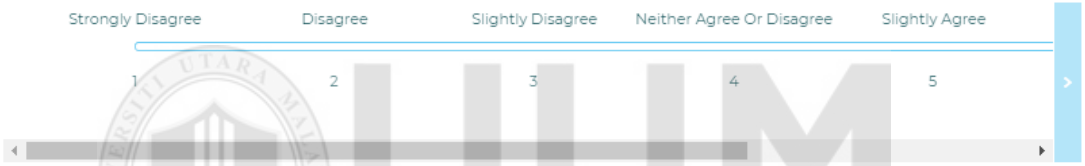
* 37. Our company periodically or regularly assesses its patents risks.



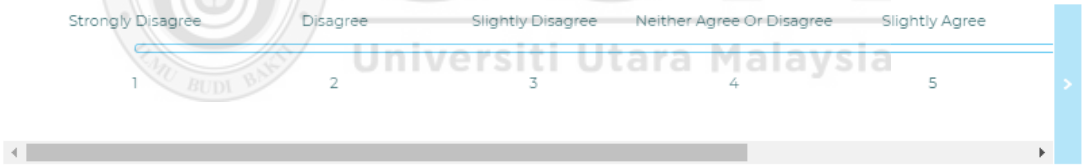
* 38. Our company regards patent protection as a feasible way to protect its innovative technologies.



* 39. Our company has a special department or designated staff to deal with patent protection.



40. Our company has owned patents in the production and provision of its leading products or services.



* 41. The increase in resources for innovative product development is mostly satisfied with top management.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 42. Our company's patents receive market recognition.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 43. Our company R&D, production, marketing, and other functions team collaboration for new product development IP generation are strong.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

UUM DBA Research Study

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The Effect Of Organizational Capabilities Towards R&D Project Innovation Performance in Penang E&E Manufacturing firms.

* Required Information

Here are some statements that describe your company R&D Project Innovation Performance. Please indicate how strongly you agree or disagree with each of them.

* 44. Our product relied on technology never used in the industry before.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 45. Our product caused significant changes in the whole industry.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

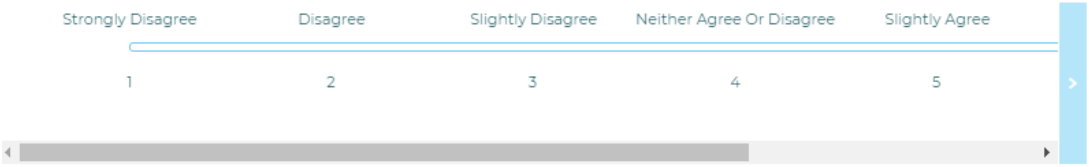
* 46. Our product was highly innovative- totally new to the market.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

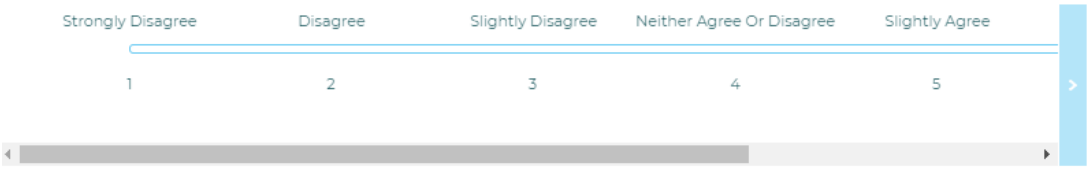
* 47. Compared to the competitive products, our product offered some unique features or attributes to the customer.

Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Or Disagree	Slightly Agree
1	2	3	4	5

* 48. The technology used to develop new product was new for our company.

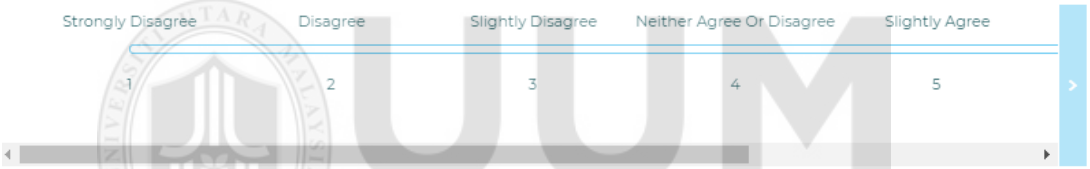


49. New engineering and design approaches were used to develop a new product.

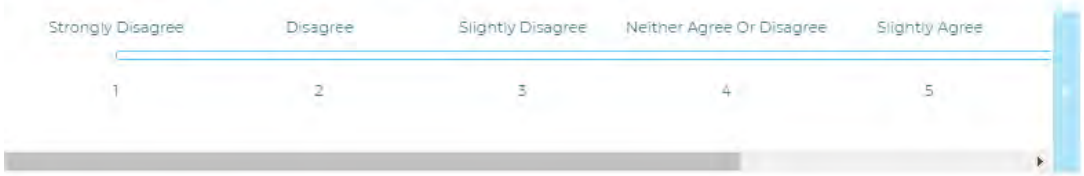


50. Compared with competitors, our company has more patents.

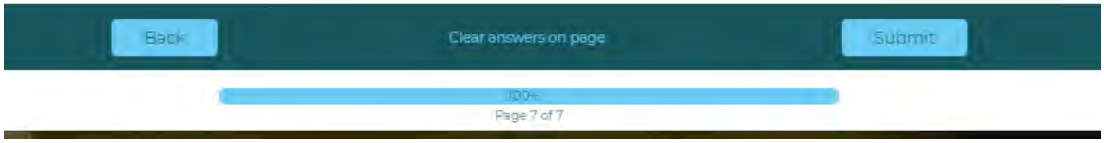
51. Our company's patents are the main contributors to profit growth.



52. Compared with competitors, our company has a higher innovation success rate.



UUM DBA Research Study



APPENDIX C: SPSS DATA ANALYSIS RESULTS

```
RELIABILITY
  /VARIABLES=Tech1 Tech2 Tech4 Tech5
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Reliability

Scale: ALL VARIABLES [Technoloy Capabilities Independent Variable]

Case Processing Summary

		N	%
Cases	Valid	56	100.0
	Excluded[a]	0	.0
	Total	56	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.870	4


```
RELIABILITY
  /VARIABLES=Cust2 Cust3 Cust4 Cust5 Cust6
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Reliability

Scale: ALL VARIABLES [Customer Relationship Management Capabiliti es Independent Variable]

Case Processing Summary

		N	%
Cases	Valid	56	100.0
	Excluded[a]	0	.0
	Total	56	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.743	5

```
RELIABILITY
  /VARIABLES=MKT1 MKT2 MKT3 MKT4 MKT5 MKT6
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Reliability

Scale: ALL VARIABLES [Marketing Capabilities Independent Variable]

Case Processing Summary

		N	%
Cases	Valid	56	100.0
	Excluded[a]	0	.0
	Total	56	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.956	6

```
RELIABILITY
  /VARIABLES=Mgm4 Mgm5 Mgm6 Mgm7 Mgm8 Mgm9 Mgm10 Mgm11 Mgm12
```

```
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Reliability

Scale: ALL VARIABLES [Managment Capabilities Independent Variable]

Case Processing Summary

		N	%
Cases	Valid	56	100.0
	Excluded[a]	0	.0
	Total	56	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.953	9

```
RELIABILITY
  /VARIABLES=Inno1 Inno2 Inno3 Inno4 Inno5
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Reliability

Scale: ALL VARIABLES [R&D Project Innovation Performance Dependent Variable]

Case Processing Summary

		N	%
Cases	Valid	56	100.0
	Excluded[a]	0	.0
	Total	56	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.802	5

```
FACTOR
  /VARIABLES Tech1 Tech2 Tech4 Tech5 Cust2 Cust3 Cust4 Cust5 Cust6 MKT1 MKT2 M
KT3 MKT4 MKT5 MKT6
    Mgm4 Mgm5 Mgm6 Mgm7 Mgm8 Mgm9 Mgm10 Mgm11 Mgm12
  /MISSING LISTWISE
  /ANALYSIS Tech1 Tech2 Tech4 Tech5 Cust2 Cust3 Cust4 Cust5 Cust6 MKT1 MKT2 MK
T3 MKT4 MKT5 MKT6
    Mgm4 Mgm5 Mgm6 Mgm7 Mgm8 Mgm9 Mgm10 Mgm11 Mgm12
  /PRINT INITIAL KMO EXTRACTION ROTATION
  /FORMAT BLANK(0.5)
  /PLOT EIGEN
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=CORRELATION.
```


Factor Analysis

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.837
Bartlett's Test of Sphericity	Approx. Chi-Square	1249.980
	df	276
	Sig.	.000

Communalities

	Initial	Extraction
Tech1	1.000	.667
Tech2	1.000	.671
Tech4	1.000	.848
Tech5	1.000	.756
Cust2	1.000	.611
Cust3	1.000	.503
Cust4	1.000	.601
Cust5	1.000	.529
Cust6	1.000	.539
MKT1	1.000	.883
MKT2	1.000	.865
MKT3	1.000	.828
MKT4	1.000	.696
MKT5	1.000	.908
MKT6	1.000	.795
Mgm4	1.000	.741
Mgm5	1.000	.863
Mgm6	1.000	.853
Mgm7	1.000	.811
Mgm8	1.000	.671
Mgm9	1.000	.782
Mgm10	1.000	.720
Mgm11	1.000	.677
Mgm12	1.000	.714

Extraction Method: Principal Component Analysis.

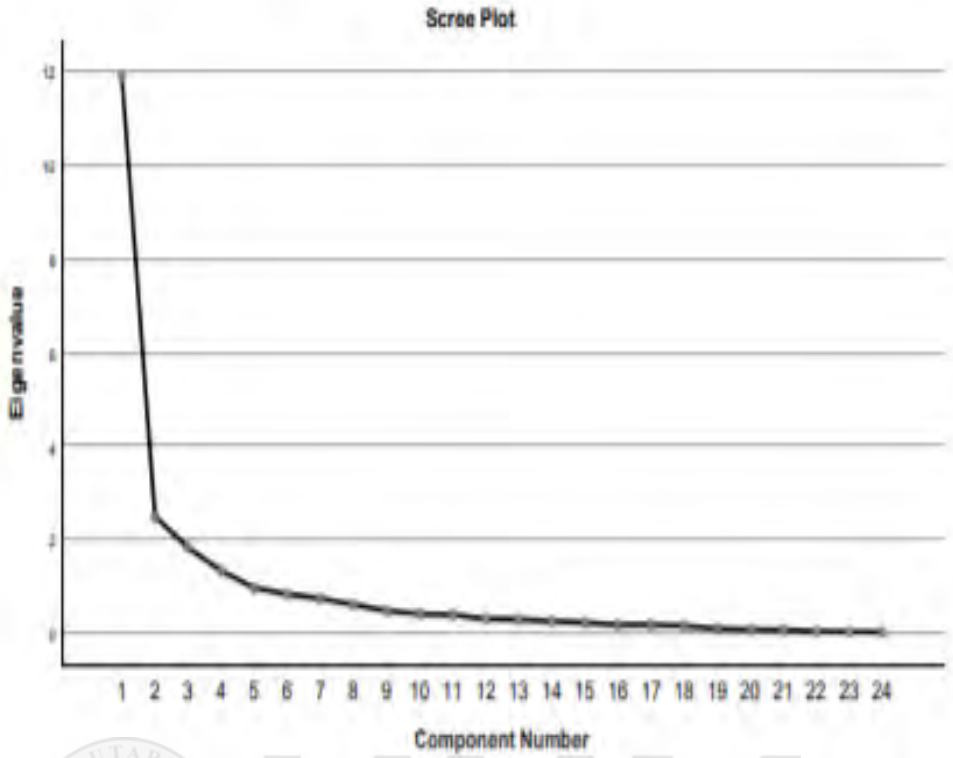
Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.874	49.474	49.474	11.874	49.474	49.474
2	2.492	10.382	59.855	2.492	10.382	59.855
3	1.829	7.619	67.474	1.829	7.619	67.474
4	1.336	5.568	73.043	1.336	5.568	73.043
5	.972	4.048	77.091			
6	.839	3.496	80.586			
7	.746	3.107	83.694			
8	.616	2.566	86.260			
9	.484	2.015	88.275			
10	.417	1.737	90.013			
11	.401	1.670	91.683			
12	.311	1.295	92.978			
13	.299	1.245	94.223			
14	.262	1.090	95.313			
15	.226	.941	96.254			
16	.189	.787	97.041			
17	.184	.767	97.808			
18	.164	.682	98.489			
19	.100	.419	98.908			
20	.081	.338	99.246			
21	.072	.300	99.546			
22	.046	.190	99.736			
23	.039	.162	99.897			
24	.025	.103	100.000			

Total Variance Explained

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	6.464	26.933	26.933
2	5.491	22.878	49.811
3	3.096	12.902	62.712
4	2.479	10.331	73.043
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

Extraction Method: Principal Component Analysis.



Component Matrix[a]

	Component			
	1	2	3	4
Tech1	.635			
Tech2	.698			
Tech4	.714			.506
Tech5	.722			
Cust2	.615			
Cust3	.522			
Cust4			.708	
Cust5			.654	
Cust6			.527	
MKT1	.794			
MKT2	.827			
MKT3	.727			
MKT4	.735			
MKT5	.804			
MKT6	.765			
Mgm4	.662	-.538		

Component Matrix[a]

	Component			
	1	2	3	4
Mgm5	.777	-.502		
Mgm6	.847			
Mgm7	.817			
Mgm8	.724			
Mgm9	.801			
Mgm10	.761			
Mgm11	.770			
Mgm12	.773			

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

Rotated Component Matrix[a]

	Component			
	1	2	3	4
Tech1			.706	
Tech2			.652	
Tech4			.780	
Tech5			.708	
Cust2				.566
Cust3				.589
Cust4				.757
Cust5				.716
Cust6				.596
MKT1		.847		
MKT2		.825		
MKT3		.868		
MKT4		.745		
MKT5		.876		
MKT6		.810		
Mgm4	.845			
Mgm5	.884			
Mgm6	.800			
Mgm7	.816			

Rotated Component Matrix[a]

	Component			
	1	2	3	4
Mgm8	.763			
Mgm9	.803			
Mgm10	.678			
Mgm11	.679			
Mgm12	.752			

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 5 iterations.

Component Transformation Matrix

Component	1	2	3	4
1	.655	.583	.407	.254
2	-.718	.677	.112	.120
3	-.109	-.282	-.015	.953
4	-.208	-.350	.906	-.113

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

```
DATASET ACTIVATE DataSet1.

SAVE OUTFILE='C:\Users\User\OneDrive\Thesis Dissertation\Final Thesis Writeup\
New Data '+
    'Analysis\Final Run\FinalRun31stDec.sav'
  /COMPRESSED.
FACTOR
  /VARIABLES Inno1 Inno2 Inno3 Inno4 Inno5
  /MISSING LISTWISE
  /ANALYSIS Inno1 Inno2 Inno3 Inno4 Inno5
  /PRINT INITIAL KMO EXTRACTION ROTATION
  /FORMAT BLANK(0.5)
  /PLOT EIGEN
  /CRITERIA MINEIGEN(1) ITERATE(25)
  /EXTRACTION PC
  /CRITERIA ITERATE(25)
  /ROTATION VARIMAX
  /METHOD=CORRELATION.
```

Factor Analysis

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.675
Bartlett's Test of Sphericity	Approx. Chi-Square	163.034
	df	10
	Sig.	.000

Communalities

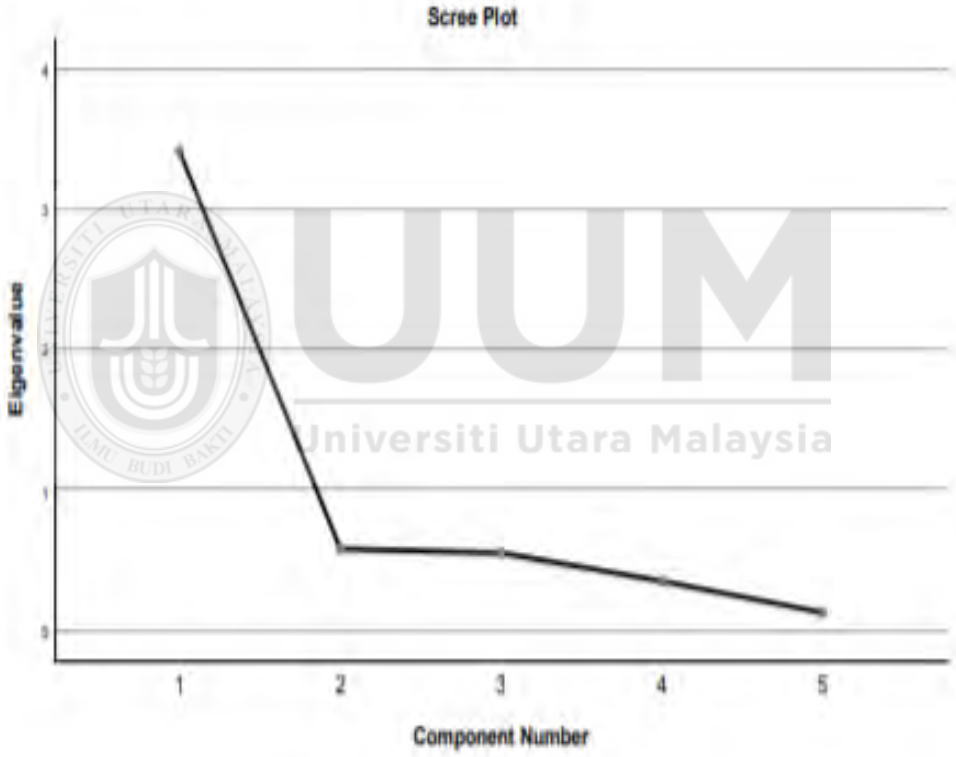
	Inital	Extraction
Inno1	1.000	.678
Inno2	1.000	.612
Inno3	1.000	.745
Inno4	1.000	.885
Inno5	1.000	.693

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.412	68.242	68.242	3.412	68.242	68.242
2	.576	11.513	79.755			
3	.546	10.917	90.672			
4	.345	6.908	97.580			
5	.121	2.420	100.000			

Extraction Method: Principal Component Analysis.



Component Matrix[a]

	Component 1
Inno1	.823
Inno2	.782
Inno3	.863
Inno4	.828
Inno5	.832

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Rotated Component Matrix[a]

a. Only one component was extracted. The solution cannot be rotated.

```
CORRELATIONS
  /VARIABLES=TechMean CustMean MktMean MgmMean InnoMean
  /PRINT=ONETAIL NOSIG
  /MISSING=PAIRWISE.
```

Correlations

Correlations

		TechMean	CustMean	MktMean	MgmMean	InnoMean
TechMean	Pearson Correlation	1	.463**	.645**	.639**	.506**
	Sig. (1-tailed)		.000	.000	.000	.000
	N	56	56	56	56	56
CustMean	Pearson Correlation	.463**	1	.477**	.439**	.350**
	Sig. (1-tailed)	.000		.000	.000	.004
	N	56	56	56	56	56
MktMean	Pearson Correlation	.645**	.477**	1	.602**	.611**
	Sig. (1-tailed)	.000	.000		.000	.000
	N	56	56	56	56	56
MgmMean	Pearson Correlation	.639**	.439**	.602**	1	.781**
	Sig. (1-tailed)	.000	.000	.000		.000
	N	56	56	56	56	56
InnoMean	Pearson Correlation	.506**	.350**	.611**	.781**	1
	Sig. (1-tailed)	.000	.004	.000	.000	
	N	56	56	56	56	56

**. Correlation is significant at the 0.01 level (1-tailed).

```
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS R ANOVA COLLIN TOL CHANGE ZPP
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT InnoMean
  /METHOD=ENTER TechMean CustMean MktMean MgmMean
  /SCATTERPLOT=(*ZRESID ,*ZPRED)
  /RESIDUALS DURBIN
  /SAVE RESID.
```

Regression

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	MgmMean, CustMean, MktMean, TechMean[b]	.	Enter

a. Dependent Variable: InnoMean

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	df1
1	.805[a]	.648	.620	.76684	.648	23.457	4

Model Summary[b]

Model	Change Statistics		Durbin-Watson
	df2	Sig. F Change	
1	51	.000	1.543

a. Predictors: (Constant), MgmMean, CustMean, MktMean, TechMean

b. Dependent Variable: InnoMean

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	53.746	4	13.436	23.457	.000[b]
	Residual	29.213	51	.573		
	Total	82.959	55			

a. Dependent Variable: InnoMean

b. Predictors: (Constant), MgmMean, CustMean, MktMean, TechMean

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations
		B	Std. Error	Beta			Zero-order
1	(Constant)	1.049	.782		1.342	.186	
	TechMean	-.093	.117	-.096	-.794	.431	.506
	CustMean	-.067	.156	-.042	-.427	.671	.350
	MktMean	.289	.124	.273	2.324	.024	.611
	MgmMean	.594	.098	.697	6.045	.000	.781

Coefficients[a]

Model		Correlations		Collinearity Statistics	
		Partial	Part	Tolerance	VIF
1	(Constant)				
	TechMean	-.110	-.066	.472	2.117
	CustMean	-.060	-.035	.717	1.395
	MktMean	.309	.193	.500	2.002
	MgmMean	.646	.502	.520	1.924

a. Dependent Variable: InnoMean

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	TechMean	CustMean	MktMean
1	1	4.904	1.000	.00	.00	.00	.00
	2	.047	10.255	.12	.04	.04	.00
	3	.024	14.418	.04	.42	.01	.17
	4	.018	16.528	.01	.53	.00	.82
	5	.008	24.958	.82	.01	.94	.01

Collinearity Diagnostics[a]

Model	Dimension	Variance ... MgmMean
1	1	.00
	2	.35
	3	.63
	4	.00
	5	.01

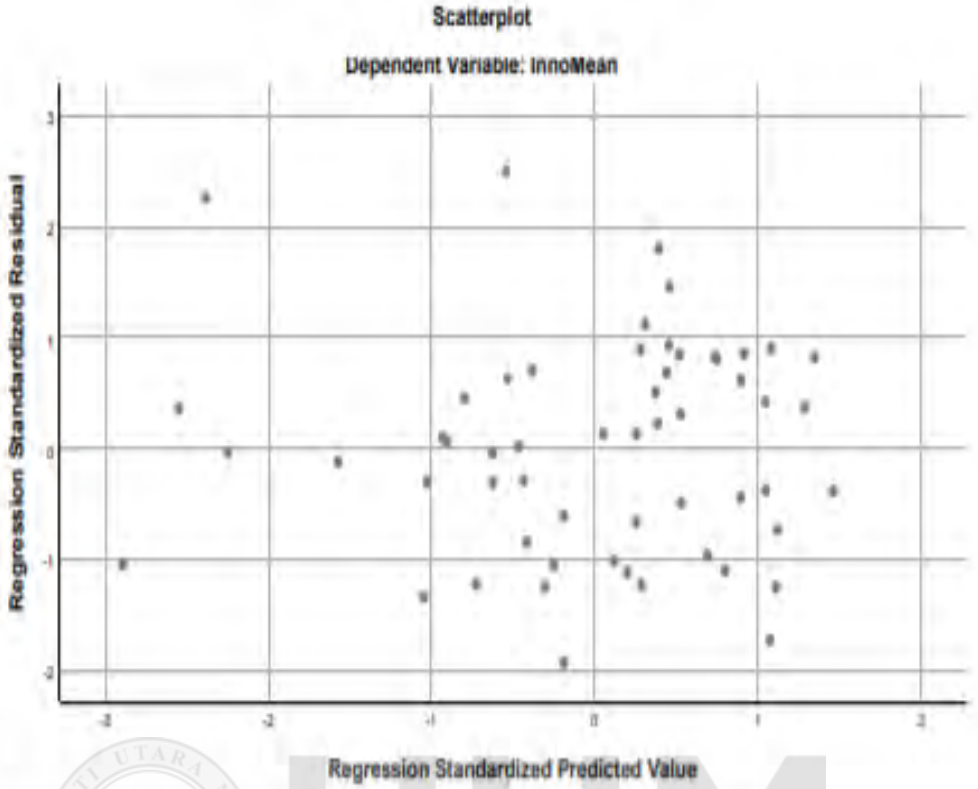
a. Dependent Variable: InnoMean

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.7867	6.0910	4.6464	.96853	56
Residual	-1.45733	1.89007	.00000	.72880	56
Std. Predicted Value	-2.893	1.461	.000	1.000	56
Std. Residual	-1.926	2.497	.000	.963	56

a. Dependent Variable: InnoMean

Charts




```
NPAR TESTS
  /K-S(NORMAL)=RES_1
  /K-S(UNIFORM)=RES_1
  /K-S(POISSON)=RES_1
  /K-S(EXPONENTIAL)=RES_1
  /MISSING ANALYSIS.
```

NPar Tests

One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		56
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	.72880204
Most Extreme Differences	Absolute	.077
	Positive	.077
	Negative	-.047
Test Statistic		.077
Asymp. Sig. (2-tailed)		.200[c,d]

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

d. This is a lower bound of the true significance.